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THE NEW SYDENHAM
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VOLUME XVIII.

THE
AURAL SURGERY
OF THE PRESENT DAY.

BY
DR. W. KRAMER,
BERLIN.

WITH TWO TABLES AND NINE WOODCUTS.

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WITH CORRECTIONS AND NUMEROUS ADDITIONS
BY THE AUTHOR.

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THE
AURAL SURGERY
OF THE PRESENT DAY.

SECTION I.

GENERAL SURGERY OF THE EAR.

THE old dispute for precedence between the eye and the ear admits of an easy solution, if we consider these two most important senses in their relation to the several ages of man, and to his external and internal life.

Thus the child, during the second and third years of life, even when blindness exists, acquires, by the ear alone, easily and playfully as it were, by intercourse with those who speak, the power of speech, the true stamp of man. Those who are deaf born, or who become so before the expiration of the seventh year, either never acquire the power of speech in this natural way, or again forgetting what has been early learnt, remain or become dumb, and thus lose the most important as well as the most natural means for intellectual and spiritual culture. Acute hearing is, therefore, of inestimable value for the period of childhood.

On the other hand, it is at the entrance into the period of adolescence, the possession of voice rendered sure, the elements of intellectual and spiritual life alike acquired, that the occurrence of deafness exercises as fatal an influence in checking the healthy development of the mind as the occurrence of blindness, so that at this period of life the importance of both of these organs of sense may be held to be equal.

Lastly, the full-grown man passes forth from the quiet circle of his family into public life. He claims independency, and enters into active relations with the external world. He then needs perfect sight incalculably more than acute hearing. Under these circumstances, it is not surprising, considering the high importance of this protracted, intellectual, and peculiarly social period of life, during which the sense of sight is universally acknowledged to be of the utmost value, that to the eye should be given an unqualified, even though a somewhat unfair, precedence to the ear.

Unfortunately, moreover, the latter possesses a rigid form, destitute of expression ; its organic changes are difficult to recognise, its functional disturbances are numerous, easily produced, and often self-deceptive, and there are still additional inconveniences arising from the difficulty of holding personal intercourse with the sufferer ; all circumstances, however, which should only lead to increased attention and care in respect to the diseases of this important organ.

The anatomy of the ear may, indeed, be considered for the present perfect. It is never requisite, in a practical point of view, to know whether the membrana tympani consists of three or five membranous layers, and whether these are essentially distinct, or only separable from one another by nice dissection : whether upon its inner surface one, or even two "pouches" are discoverable or not, or in what way the auditory nerve appears, under the microscope, to ramify and terminate, &c.

Undoubtedly, every reader of surgical works upon the ear (which are, in general, but little adapted for popular perusal), must set out with an accurate knowledge of the organ of hearing ; and it therefore appears useless to enter—for the description of the diseases of the external, middle, and internal ear, and for the various operations—into any anatomical details of the organs alluded to ; for nothing could be introduced but what can easily be acquired by all readers from the various hand-books of anatomy.

Scarcely any attempt has yet been made to solve the most difficult problem connected with the pathological anatomy of the ear—the inquiry into the disorganizations of the membranous and bony labyrinth ; nor, though we may indeed regret it, is this a matter of astonishment when we reflect upon the many and great difficulties which oppose themselves to such investigations.

The following morbid conditions have been found in the tympanic cavity upon dissection :—the membrana tympani in all instances re-

maining uninjured ; effusion of serum ; the remains of hæmorrhagic effusion ; tough, stringy mucus ; mucous granules, muco-purulent fluid ; inflammatory-exudation-granules ; hyperæmia of the mucous membrane ; various shades of redness, and various degrees of swelling ; spongy hypertrophy, and false membranes, in which the ossicula lie more or less imbedded, and are, at the same time, either ankylosed together or to the surrounding parts, this occurring, in particular, between the base of the stapes and the fenestra ovalis ; the membrane of the fenestra rotunda is sometimes thickened, and may even be ossified ; the Eustachian tube constricted, in consequence of spongy swelling of its mucous membrane, and stuffed with mucus ; the cells of the mastoid process have, in like manner, been found filled with the same abnormal products that were contained in the tympanic cavity, and with similar alterations of their investing membrane. These inflammatory products have, for the most part, been found in the post-mortem examinations of those who have died of severe febrile affections (pneumonia, phthisis, nervous and gastric fevers, and the exanthemata), in whom also similar products of abnormal nutrition were present on the investing membranes of the nasal, pharyngeal, and oral cavities, and on those of the trachea and intestinal canal. It is still doubtful how far these abnormal conditions of the tympanic cavity may occur in those who have never suffered from such febrile affections, or who have only experienced a slight attack. Now, it has so happened that only in very few cases where dissections have been made has it been ascertained that any hardness of hearing really existed during life, whilst the exact degree of that deafness has never been, in any case, determined ; and we are, therefore, by no means in a position to state with certainty that these morbid conditions of the tympanic cavity are the true cause of deafness generally, or of any particular grade of it.

We cannot but regret the neglect of instrumental investigation during the lifetime of the patients of such ears, as have been subsequently obtained for dissection, since it is on this account that we are still unable, when the membrana tympani is uninjured, to furnish any sore diagnosis founded on physical signs, of the various diseases of the tympanic cavity. It is important to observe that with these remarkable abnormal conditions of the tympanic cavity the quantity of endo-lymph and peri-lymph contained in the membranous labyrinth was perfectly natural, furnishing a strong proof of the protection which is afforded to the auditory nerves by their isolation

in febrile diseases proceeding to a fatal termination and affecting sympathetically and seriously the surrounding parts. When the patient has suffered from certain chronic affections, deposits of pigment, crystals of chloride of sodium and of carbonate of lime may be discovered in the labyrinth; or there may be well-marked injection of the blood-vessels; atrophy of the auditory nerves or of their centric extremities, from the pressure of tumours developed in the cranial cavity, or lastly, deficiency in the number of their roots arising from the floor of the fourth ventricle, a condition which is especially found in cases of congenital deafness.

The physiology of the human ear can hardly be expected to make any advance from the study of comparative anatomy and physiology, since it will always remain unknown in what manner and to what degree the power of hearing in man differs from that possessed by the various races of animals, and upon what modifications of structure these differences depend. Moreover, since the human ear has not only to hear inarticulate sounds and noises, but also to comprehend articulate (vocal) sounds as well, which requires a very high degree of development in this organ, it must be apparent that no comparison can be made between this faculty as it exists in man and that possessed by animals.

The only direct attempts to ascertain the acoustic and physiological functions of the several parts of the organ of hearing have been made upon the cartilage of the auricle. For this purpose a watch is most conveniently employed, the movements of which can be heard only within a very short distance by the healthy ear (mine, for instance, is only audible within twenty-one inches). The experiment should, of course, always be made when everything is quiet; and if we are ourselves the subject of it, we should stand before a large mirror.

If we now cover over the cartilages of both ears with thick flannel dipped in warm water, and stretched on a wire frame made to fit closely the line of attachment of the cartilage, and also covering the floor of the concha, yet so that the entrance of the aperture of the meatus remains free, we shall find that the beat of the watch can only be heard at the distance of fourteen instead of twenty-one inches, a diminution which is to be attributed to the prevention by the flannel cover of that resonance and concentration of sound which is effected by the windings and sinuosities of the surfaces of the auricle.

When the auricle of one or of both ears is pressed forwards towards the cheeks with the hand, it will be found that both articulate and inarticulate sounds can be heard with increasing clearness the nearer the helix is approximated to the cheek; this can only be ascribed to the greater resonance of the extended auricle.

If the watch be held opposite the uncovered auricle in such a manner that its face is parallel with the bottom of the concha, the beat can be heard about three inches further than when its face is placed directly opposite the entrance of the meatus. This singular effect, which is observable also in those who are hard of hearing, and may always be noticed in watches which beat gently, is a strong argument in favour of the power of the concha to concentrate sound, and this conclusion is by no means invalidated by reported observations that after loss of the concha, by a cut or other injury, the power of hearing was not diminished, because it is impossible to prove that no diminution in the power of hearing has been experienced. In these extremely superficial observations the precaution has not even been taken to close the uninjured ear! No investigations have ever been made as to whether any influence is exercised upon the concentration of the waves of sound by the tortuous direction and the funnel-shaped expansion of the meatus externus. At all events, slight differences in its diameter do not appear in any way to affect the faculty of hearing, as we may deduce from a comparison of the delicate and finely organized ear of the female with the more strongly developed organ of the male, in whom the meatus is considerably wider, and yet common experience shows that the faculty of hearing may be equally acute in both.

The hearing is found to be injuriously affected whenever the meatus is filled up by cerumen or pus, or is closed by the growth of polypi, by foreign bodies, by spongy swelling of the dermis and cellular tissue, or by hypertrophy of the dermis. The extent to which the hearing is affected is in exact proportion to the completeness of the closure and to the nature of the obstruction in regard to its power of conducting sound.

Daily experience is in opposition to Erhard's statement, that "inflammatory narrowing of the meatus may exist with undiminished power of hearing," and it is equally incorrect to say that new-born children hear perfectly with their extremely small meatus. On the contrary, their hearing is very imperfect or even altogether absent,

as we may conclude from the extremely sound manner in which they sleep during the first months of life. It is only about the middle of the first year that they give unquestionable evidence of hearing by turning the head on the occurrence of a loud noise, music, &c., and it is not until about the second or third year that the acquisition of speech proves their hearing to be perfect.

The well-marked curvature of the meatus, contracted in its central part, invested in its anterior half with a layer of glutinous cerumen, even though it be uncovered and exposed to the changes of the weather, and scarcely constituting an effective impediment to the entrance of cold air or of cold water (as in submersion), is nevertheless an excellent protection for the tender tympanic membrane and the internal parts of the organ.

We can only conjecture that the normal strong concavity of the membrana tympani is subservient to the concentration of the aerial waves of sound falling upon it, but its smoothness and polish and its evident tension are obviously indispensable for normal hearing, for we observe that any crack or fissure (which usually occurs along the handle of the malleus) very decidedly interferes with the power of hearing, both quantitatively and qualitatively (as, for example, in the right appreciation of musical sounds). This occurs instantaneously, and therefore before the occurrence of inflammatory conditions in the immediate vicinity of the fissure.

The degree of translucency of this delicate membrane which is present in health is equally important for normal hearing, for every effusion of plastic lymph between its layers, occurring as a consequence of inflammation produced by bathing in cold water or by dropping stimulating fluids into the meatus, deprives the membrane of its translucency, and with this there is a very decided diminution in the capacity for hearing, as may easily be shown by taking the trouble to close the unaffected ear and experimenting on the other with the voice and with a watch.

It is therefore perfectly erroneous to say, with Erhard, that "the most distinctly marked inflammations of the membrana tympani have been observed without any deficiency in the power of hearing."

That "the concave condition of the membrana tympani is of no importance" will never be proved by the mere assertion that the "concave membrana tympani of man possesses the same power of concentrating the waves of sound as the perfectly flat membrane of the mole or the convex membrane of the bird" (Erhard).

Erhard has adduced no proofs of the "equal" capacity for hearing in man, in the mole, and in birds, various as the condition of their membranes may be; but even if we grant his proposition that the membrana tympani is alike subservient in conducting the waves of sound, whether it be concave, plane or convex, still this proves nothing against the circumstance that special acoustic peculiarities may be connected with special forms of that membrane.

When we reflect with what force the air is often driven into the tympanic cavity against the membrana tympani in blowing the nose, so that it is even rendered convex on each side of the handle of the malleus, we can easily understand that this delicate little membrane needs at such times a strong protection lest it should be ruptured. This is afforded to it, in the first place, by its convexity being directed inwards, and in the second place by that convexity being secured by the insertion of the handle of the malleus; and though this arrangement may not afford quite sufficient support to it when it is affected by sounds of great volume and power, yet it is a very rare event for these to produce a rupture. It is very evident also that this support and protection against injury is materially increased by the union of the malleus with the other moveable, resilient and angularly placed ossicula. It is in this circumstance that the peculiar value of the chain of small bones seems to consist. It is usual to consider them as the means whereby the waves of sound are propagated from the membrana tympani to the labyrinth, but surely it is incumbent upon those who entertain this opinion to explain why this end would not have been better attained by a single bone than by three bones, whose continuity is broken and which are connected together in an angular fashion.

Müller's experimental evidence of the conduction of sound through the ossicula proves nothing (see above), and has received no support from any other quarter; I may therefore immediately adduce the arguments in favour of the conduction of sound taking place through the air contained in the tympanic cavity and through the membrane of the fenestra rotunda to the labyrinth. In support of this view I must rest on evidence derived from pathology alone, for it is impossible to adduce direct physiological facts upon such a question. It is clear that we ought to obtain correct ideas in regard to the conduction of sound through the ossicula before proceeding to consider the recently so much talked of "vibratory power of the ossicula, and the hindrance to this which results from diseased conditions of the

investing membrane of the bones and ligaments." All bodies are certainly vibratory, and consequently can conduct sound, but only some of these (and then only under certain circumstances) are musical when vibrations of sound are excited in them. The conduction of sound occurs quite independently of the condition of the surface of the bodies in question, and passes uninfluenced through their substance, except in so far as it is affected by its degree of density. On the other hand, the musical quality of various bodies is essentially dependent upon the condition of their surfaces. A tuning-fork, a rod of silver, of steel, or of glass, conducts sound equally well when one end rests upon a watch and the other touches the bones of the head or the teeth, whether these bodies are tightly held in the hand, are covered, or are perfectly free; but they are only musical when, for example, the struck tuning-fork is so held that it may vibrate with freedom, or when we strike the glass, silver, or steel rod against some hard body whilst it is suspended by a thread. Every kind of cover which is applied to these bodies takes away their musical quality completely and immediately, without at all affecting their power of conducting sound. If we now turn from this to the "vibratory power of the ossicula," no one will attribute to these bones a musical quality, but every one will admit a conducting power, and it must be clear, from what has been said above, that this depends purely on their atomic condition and arrangement, and is quite independent of the condition of their surfaces (the investing membrane or periosteum), which cannot in any way affect it.

It follows, therefore, that the vibrations of the ossicula, as regards the conduction of sound, will not, as Erhard thinks, be interfered with if their investing membrane be thickened, indurated, swollen, covered with mucus, or in any other way diseased; this holds also in respect to similar conditions of the ligaments and of the ossicula; for induration and, still more, ossification of the ligaments approximate them in their atomic constitution to the small bones, and must consequently facilitate the conduction of sound through this chain, by rendering it a more homogeneous mass, instead of hindering it, as Erhard imagines. This being premised, we can easily understand the physiological importance of the following facts. There are numerous persons hard of hearing, in whom we can discern neither in the meatus nor in the tympanic membrane any deviation from the healthy condition. But if we introduce the catheter into the

Eustachian tube, and blow through it so strongly that the air passes into the tympanic cavity, and is propelled against the membrana tympani, we can hear by means of the diagnostic tube, properly applied, a rattling mucous noise in the ear of the patient, who immediately after perceives considerable improvement in his hearing, both for articulate and inarticulate sounds, and feels that his ear is freer. If this operation of blowing in air be repeated the next day, the sound of the air passing in becomes clearer and less mucous, and the hearing is correspondingly improved until, after some days or weeks, when the tone of the in-blown air has attained its normal clear, soft character, the hardness of hearing is entirely removed.

The cure of many uncomplicated cases requires the employment of no other local means than these, and in such patients the hardness of hearing may literally be said to be blown away. It must, therefore, have had a moveable cause, and whether this has existed in the tympanic cavity, in the Eustachian tube, or in both, is a matter of no moment ; it must, moreover, have been of a humid nature, whether mucous or serous. According to the above remarks, this exudation cannot have interfered with the conduction of sound by ensheathment of the ossicula, and therefore the cause of the hardness of hearing can only be sought in the filling up of the tympanic cavity or in the exudation upon its walls, and especially upon the membrane of the fenestra rotunda and in the consequently diminished power of conduction of sound in these parts. Hence the cure of the hardness of hearing commences as soon as the moist mucus (a bad conductor of sound) is removed by insufflation from the tympanic cavity and from the membrane of the fenestra rotunda, and is replaced by the atmospheric air, which is a good conductor of sound ; the clean surface of the membrane of the fenestra rotunda then once more vibrates normally.

The same phenomena may be observed in the membrana tympani when this has been either completely or only partially covered, and has again been freed from moist and adherent mucus.

Now, it is asserted, without the possibility of proof, that accumulations of mucus never exist in the tympanum, but only in the Eustachian tube (Erhard). Even granting this hypothesis, nothing is gained in proof of the conduction of sound through the ossicula, because we cannot understand how the mucus in the tube should operate in preventing the sounds which impinge upon the healthy membrana tympani from being taken up by the healthy handle of

the mucus and conducted by the healthy ossicula to the healthy labyrinth. That all these parts must really be healthy is evident from the return of normal hearing on simply blowing air frequently into the tympanic cavity. Lastly, if it be alleged against the conduction of sound taking place through the air of the tympanic cavity, "that the latter is, in the early years of life, constantly more or less filled with a thin, fluid secretion from its mucous membrane, so that no air is contained within it, as the dissection of the ears of children who were possessed of perfect hearing proves, and as is also shown by catheterism during life" (Erhard), we may question, in the first place, whether, if such results are found upon dissection, they are not to be regarded as the products of the disease which has proved fatal, than that they constitute the normal condition of the tympanum of the child. It would, moreover, be very difficult for Erhard to prove that these children had heard normally up to the moment of death. And again, would the parents of children whose hearing is perfect allow Erhard or any other physician to catheterize them during the first years of life—without mentioning the extreme difficulty there would be in accomplishing this operation. At the earliest period I have performed the operation, viz., on children of four years of age who were hard of hearing, the tympanic cavity was indeed filled with mucus, and when this was blown out in the manner above described the hearing was immediately and perfectly restored; but this only furnishes a satisfactory proof that mucus in the tympanic cavity is not a normal condition in children of four years of age, nor is necessarily associated with perfect hearing. Upon the whole, therefore, there is every probability that the conduction of sound from the membrana tympani to the labyrinth is chiefly effected through the air of the tympanic cavity and the membrane of the fenestra rotunda. The latter consequently acquires special significance, its peculiar concealed position being of little importance when we reflect upon the imperfect information we possess in regard to the resonance and other acoustic properties of irregular-walled cavities like the tympanum.

Moreover, if "the oval fenestra is the only one constantly present in the lower orders of animals, from which circumstance we may argue for the small importance and dispensability of the round fenestra" (Erhard), such a line of argument is much more in favour of the importance than of the unimportance of any additional part, as may easily be shown by a reference to the addition made in

the development of any other organ, as, for example, the brain amongst the higher orders of animals.

The bony base of the tympanic cavity (the covering of the labyrinth) undoubtedly conducts waves of sound from it to the auditory nerve, of which we may assure ourselves by the patient's possessing in many instances a very fair power of hearing though the *membrana tympani* may be completely broken down, the ossicula destroyed by ulceration, and the round and oval fenestra closed up. In these cases the investing membrane of the tympanum is not spongy and thickened, but smooth and adherent, moderately reddened, with the secretion either diminished or altogether absent, the *fenestra ovalis* only represented by a shallow dimple, and very probably closed by bony substance. In these cases the auditory nerve, imbedded in the bony labyrinth, must be considered as the real seat of the special sensibility to sound, since any compression of its centric extremity by tumours developed within the cranium is followed by absolute deafness. No regard need be paid to the argument of Pappenheim against the constant coincidence of these morbid symptoms with deafness, since the woman, on the dissection of whom "a firm tumour of an inch in diameter was found compressing the facial and auditory nerves," had been observed so little during life, that, he adds, "she ought not to have been hard of hearing." The physiological importance of the several parts of the membranous labyrinth is veiled in the utmost obscurity. After what has been said above in proof of the great probability that the conduction of sound is chiefly effected by means of the air in the tympanic cavity, we cannot but admit, as being still more probable, that the nerve of the cochlea plays a most important part in the perception of the waves of sound. Its remarkable size and wonderfully regular expansion upon the *lamina spiralis* give to it a clearly superior value to the ramus *vestibuli*. But if we "perhaps (! !) perceive the loudness of sound by the ramus *vestibuli*, the ramus *cochleæ* is, perhaps (! !), the means by which we estimate bass and treble notes, their pitch and timbre, and can comprehend speech" (Erhard). This is merely a vain and foolish playing with theory, for Erhard has already, in the previous part of his work, "practically reduced the value of the *fenestra rotunda*, as a membrane conducting sound, to nothing," whilst he elsewhere says "the *scala tympani* of the cochlea can only be directly affected by those waves of sound which are conducted by means of the *foramen rotundum* to the fluid of the *scala tympani*." Such contradictory statements,

resting on the most exact (! !) pathological and physiological observations, are insufficient to settle "the separate functions of these two branches of the auditory nerve," and, indeed, give no information whatever upon the function of these parts of the ear.

The great value of the sense of hearing urgently demands that extreme care should be taken of the organ in which it is lodged, though this is unfortunately only to be expected from those who are or have been deaf. This care consists essentially in the avoidance of exposure to cold and to loud noises, which are the two chief sources of injury to the organ in general, and to the auditory nerve in particular. We shall here, therefore, appropriately give some precautionary advice, the observance of which should be a duty to all who are or have been sufferers from aural disease.

The ears should not be permitted to become chilly nor to be sensibly penetrated with cold, and, in particular, a cold wind should not be allowed to strike directly upon the membrana tympani. Hence both ears should be stopped in raw, moist, cold, or frosty weather, and especially in stormy, windy weather, with unwashed and well-oiled sheep's wool (never with cotton wool, which diminishes the secretory activity of the ceruminous glands), and this should be done with so much the more care in proportion to the smallness of the quantity of cerumen. If the cold be very severe, and the exposure to it prolonged, the ears must be covered with woollen cloths, ear-flaps, &c., with the utmost care, and again, the feet should be kept warm and dry by wearing woollen stockings, overshoes, leathern shoes and boots (especially in the case of ladies), and by giving up hunting in winter, fishing, and similar pastimes.

If by chance the feet should get wet, the shoes and stockings should be changed as quickly as possible, and the feet immediately put into warm water. The ears should be cleansed with a towel dipped in soft, warm water, and should be immediately dried. The habit of cleaning out the ears of children with wet cloths is much to be censured, and the practice of dipping the head into a large basin filled with cold water, and of thus washing the ears by purposely filling them, is very injurious, because the narrowness of the meatus renders it difficult or impossible to dry the deeper-lying parts with the membrana tympani. Then, when they come into the fresh, cool air, evaporation of the moisture in the ears takes place, inevitably producing considerable cold. It is equally injurious to pour water over the ears of little children, or to wash them with

saturated sponges and soap and water. In river or sea bathing, the ears should be stopped with oiled wool, since that alone can prevent the entrance of water. If there be an angry sea and we bathe with the waves running high, we should bind closely over the ears a small linen cloth, in order to prevent the wool from being washed out of the meatus. Bathing-caps do not furnish a sufficient protection. We generally recommended escape from, or, by stopping the ears with fine linen charpie or oiled wool, prevention or moderation of, the injurious action upon the auditory nerves of the noise in mills, factories with clattering machines, blacksmiths' shops, and the workshops of copper-smiths and boiler-makers, of the noise produced by ball practice of artillery and infantry, by the use of firearms in hunting, by wind instruments, or by violins in a full orchestra, by shrieking parrots, and loud-singing canaries, and by the use of metallic instruments for hearing, though these latter should never be employed.

The hardness of hearing so frequently observed in hunters and lovers of sport is not to be so much attributed to the noise of many explosions as to the unavoidable exposure to cold which accompanies such pursuits.

Amongst the symptoms of diseases of the ear only two are of general importance—hardness of hearing (deafness) and noise in the ears. Diminution in the power of hearing (hardness of hearing), in its infinite modifications up to complete deafness, is never absent in aural diseases with the exception of some isolated and very circumscribed diseases of the cartilage and of some cases of noise in the ears without deafness (see Tabular view, p. 31, No. 16), as may readily be ascertained if we will only take the trouble in each case to experiment carefully on the power of hearing. Many persons first consider themselves to be hard of hearing when they are no longer in a condition to maintain easy personal intercourse in their ordinary avocations or pursuits; this in some measure explains the great variation in the stage of deafness which different patients consider the commencement of their disease, although this may have commenced at a period long antecedent. It is well known that a certain amount of hardness of hearing—that grade, for instance, which renders it difficult to comprehend vocal sounds—can be materially improved by slow speaking, by a sonorous voice in the speaker, by an acquaintance with the subject under discussion, by attention, mental activity, by quickness of apprehension, and other similar endowments

on the part of the deaf person. Hence it is very natural that, in the ordinary intercourse of the world, the same degree of deafness may be very variously estimated in different persons under various circumstances, both by the speaker and the person addressed. And now, if we admit that no one can possibly maintain his voice constantly at the same strength and pitch, and that, although the comprehension of vocal sounds is the earnest desire of all who are hard of hearing, yet we must also allow that these cannot in any way be employed as a standard or measure of the degree of deafness. It is only in cases of deafness of a doubtful nature (as, for example, in the deaf and dumb and in very young children) that we can have recourse to shouting a few vowels, consonants, syllables, or unconnected words, close to the ear of the patient, in order to judge, as accurately as possible, from their being exactly or inexactly imitated, of the degree of deafness actually present. In all other cases only inarticulate sounds which are exactly similar in force and modulation, as the beat of a watch, can serve as a measure of the degree of deafness, though it must at the same time be remembered that acute hearing for inarticulate sounds is not always associated with equally quick appreciation of vocal sounds. In order to remedy this inconvenience as far as possible in the treatment of these cases, we make the patient pay attention, not only to the distance at which he can hear a watch beat with regularity, but also how far he can hear it beat with a full, resonant, metallic sound.

It is advisable also, in the examination of the degree of deafness, to move the watch slowly from a distance towards the ear, and to indicate as the special hearing distance the point at which the beat of the watch is first perceived to occur regularly and with metallic resonance. Of course any such examination should be undertaken under circumstances in which there are no disturbing noises at hand that might drown the beating of the watch. The loudness of the beat of such a watch is a matter of little importance, if only the patient can hear it with equal distinctness with both ears, and is not of such extreme loudness that it must (in moderate deafness) be held at a very great distance from the affected ear.

It is therefore useful for these and similar cases to have a watch with feeble beat; on the other hand, another having a loud beat may be employed in cases of extreme deafness. The same watch should always be tried at the same distance from the diseased ear at which it is distinctly heard with the healthy one, a distance which we may

indicate by the expression "normal hearing distance." I use three watches in practice, the first of which can be heard by myself and all persons with healthy ears at a distance of two feet, the second at thirty feet, and the third at forty feet, when everything is quiet. The tuning-fork is not well adapted for the examination of the degree of deafness, not only because the sound produced by striking it is of variable strength, but also especially because the successive vibrations become constantly feeble till they die away, and we therefore lose that most important character of a trial note, that it should possess the same force under all circumstances.

Hardness of hearing is by no means a disease in itself, but is only a symptom of some organic change in the ear. It is therefore a sign of great ignorance and charlatanism to recommend remedies for deafness and hardness of hearing. These can only be improved in proportion to our ability to remove the organic changes to which they owe their origin.

It is in the knowledge of such structural changes that we possess the most certain means of discovering feigned deafness and hardness of hearing; the exact recognition of the several structural changes suggests at once the proper means of cure.

The second symptom of disease of the ear, which is so common, though perhaps not always present, as in cases of circumscribed disease of the auricle, is the perception of noise in the ears (see the Tabular statement). This symptom may be observed to occur without any visible cause, with the utmost variety as to intensity and modulation. It is sometimes continuous, sometimes intermittent. It may exist in one or in both ears, and in the head, but rarely in the head alone, and it may last for days, weeks, months, years, or even through the whole of life. With few exceptions, it is associated with hardness of hearing; but there is no more certain relation between the two than there is between them and the apparent structural changes of the ear, although we may certainly expect the noise in the ears will cease with the disappearance of the organic changes which called them forth. On the other hand, the noise in the ears not unfrequently ceases or continues whilst the accompanying hardness of hearing continues unchanged, or gradually increases. It is therefore a false prejudice on the part of many patients, that the noise in the ears has kept up, increased, and even produced the deafness. We are equally unable to make the diagnosis of particular forms of disease from the occurrence of certain peculiar sounds in the ear, as, for instance,

those of a musical nature, or to attribute such sounds to particular diseases, as, for example, to nervous deafness. The tabular statement refutes this in the most decisive manner.

Noise in the ear is such an extraordinarily frequent concomitant of disease in the ear that I have observed it 496 times out of 1000 cases (see Table). The sounds of the ear have been referred to very different seats; the following observations and researches may throw some light upon the subject.

If the tragus of a healthy ear be pressed deeply into the meatus, of course pressure will be made upon the drum of the ear, through the medium of the air contained in the meatus. If we pour water, oil, or quicksilver, upon the drum of the ear (the head being kept in a horizontal position), and, by means of a blunt probe, touch the membrane at the only part which is not painful, above the processus brevis mallei, under which the chorda tympani runs, as I have often done, there occurs a variously modulated noise in the ear so touched, the loudness of which increases with the mechanical pressure exercised, and wholly disappears as soon as, but not until, the pressure is removed. The fluid flows out by raising the head, and the probe may now be withdrawn. The same sound is aroused if, when the nose and mouth are closed, we make a strong expiration, and so press the air against the drum of the ear from within.

When repeated mechanical irritation is made of the easily moveable membrana tympani, the irritation is, without doubt, communicated to the chorda tympani that is so closely connected with it. Sounds in the ear, corresponding in force, and occurring by fits and starts, are thus produced, and this is only explicable on the supposition that irritation of the chorda tympani awakens, by reflex action, a state of activity in the auditory nerve, a state which is otherwise only produced by the impression of sound. The sensory fibres of the fifth pair distributed to the tympanum can have no share in this, as there is no pain.

From this point of view we can clearly understand, with the guidance of the subsequent tabular view, how noise in the ears accompanies a considerable proportion of the diseases of the ear. I found, for instance, in 163 cases of stoppage of the meatus with hardened cerumen, not less than 101 who suffered from noise in the ears. These sounds were immediately and completely removed within a quarter of an hour by thoroughly cleansing the ears with an injection of warm water. A little oil was then dropped into the meatus, and, as

Tabular View of the Diseases of the Ear in 1000 Cases.

in the above-mentioned experiments, they remained free from the noise as long as the membrana tympani was covered with oil, a proof that the collections of cerumen produced the noise only by contact with, and mechanical irritation of, the membrana, and especially of the chorda tympani. In the remaining 62 cases of this affection, without noise in the ears, we may venture to say that the collection of cerumen had not been in actual contact with the membrana tympani. In the same way mechanical irritation of the chorda tympani, by the direct contact of mucus collected in the tympanic cavity, explains the presence of noise in the ears in nine out of 48 cases of free and of free and interstitial exudation in the middle ear (see Nos. 12 and 13 in the Table), the removal of which by insufflation, in some instances improved, in others cured the deafness, but in all cases completely removed the noise in the ears. The more or less fluid nature of the collection of mucus in the tympanic cavity explains, not only the frequent spontaneous disappearance and return of the noise in the ears, but also the entire absence of this symptom of disease in circumstances which have frequently been noticed (in 25 out of 60 cases of this form of disease). Noise in the ears produced by inflammatory irritation of the chorda tympani is, as regards its pathogeny, included in the same category with the direct or indirect mechanical irritation of that nerve, as we have already described. This is in accordance with the very general occurrence of noise in the ears in inflammation of the membrana tympani and immediately adjacent parts. Thus, it occurred in acute inflammation of the membrana tympani twenty-six times in 35 cases ($= 3 : 1$) ; in simple chronic inflammation only thirteen times in 64 cases ($= 1 : 4$) ; in perforation of the chronically inflamed membrane $= 1 : 3$; in polypi springing from it $= 1 : 5$; and in perforated, chronically inflamed membrana tympani, with polypi $= 0 : 3$. Very acute inflammation of the connective tissue of the meatus—which, however, does not by any means constantly implicate the membrana tympani—is more frequently accompanied by noise in the ears (vide the Table, $7 : 11 = 1 : 1\frac{1}{2}$) ; but in the more chronic inflammation of the corium of this part of the ear ($7 : 15 = 1 : 2$). When the exudation in the middle ear is exclusively interstitial, noise in the ears occurs in the great majority of cases ($244 : 163 = 1\frac{1}{2} : 1$), and is here recorded as the result of a catarrhal irritation of the chorda tympani and of the membrane of the tympanic cavity investing it, because in all these cases of disease the noise in the ears, even when not previously

present, is always produced when strong and repeated blasts of air are blown into the tympanic cavity against the *chorda tympani*.

On the other hand, in about thirty cases of complete destruction of the membrane and of the *chorda tympani*, I have never observed noise in the ears to be an accompanying symptom. Lastly, noise in the ears is one of the most constant symptoms of complete deafness and is often present to a very intense degree (especially in those cases where the deafness is not the result of partial destruction of the tympanic membrane accompanied by disorganization of the structures in the tympanic cavity).

Noise in the ears, when it is at all severe, is always very depressing to the patient, often even more so than the accompanying deafness, and, no doubt, because it is more marked in the hours of rest and solitude. I have known an instance of a man, once strong and healthy, who voluntarily committed suicide to escape from a persistent and loud noise in the ears, which had lasted for many years.

From what has now been said it may easily be understood that noise in the ears is no disease having an independent existence, nor does it admit of any specific mode of treatment being applied to it, as is the case with other affections; and only the most careful inquiry into the local conditions of disease in the external or middle ear can furnish the proper indications for its treatment. No doubt an analogous beating in the head and in the temples is experienced where there is great congestion of the head, and in violent fevers, but there is no real noise in the ears. No doubt this symptom, if already present, will be increased by all means which excite the circulation, as by stooping, by continuous elevation of the arms, and by strong intellectual exertion: whilst, on the removal of these causes, it usually returns to its accustomed grade. Still all this by no means proves that noise in the ears owes its origin to plethora or to great nervous excitability, or to any preceding constitutional affection. It is rather to be regarded as a completely local affection of the ear, which may be produced, and is always proportionably increased, by sympathy with general derangement of the system.

Hereditary tendency must certainly be struck out of the category of the causes of aural disease. For it has lately been clearly ascertained, upon statistical data, that it is a circumstance of very rare occurrence for those who are born deaf and dumb, or who have become so during the first years of life, to transmit this peculiarity to their children (see section on Deaf-Mutism).

It cannot be denied, however, that we have sufficient grounds for admitting a certain predisposition to disease, especially in the external and middle ear, during the period of childhood and in those of a scrofulous constitution ; but it cannot be maintained that the rheumatic, gouty, herpetic, syphilitic, or scabious dyscrasiae or cachexiae have any tendency to produce aural diseases, nor even that the scrofulous diathesis itself impresses any specific character upon any of the forms of disease of this organ. We have no objective proofs of the existence of any of these specific inflammations of the membrana tympani, as, for example, of that form which Bonnafont calls "syphilitic myringitis." He only adduces three cases of this disease, and of these only one suffered from inflammation and perforation of the membrana tympani, with discharge from the ears, and there were no distinguishing peculiarities, whilst the two others presented an obscurely white membrana tympani, from which no suppuration took place.

The throat of these patients was of a violet-red colour, without any ulceration. One of them had had a superficial ulcer on the glans penis eight or nine years previously, which had healed after being twice touched with caustic ; the second had only a discharge for a few days from the urethra ; and the third had had the last chancre six years before, without suffering in the intervening period from secondary or tertiary symptoms, so that in none of them was any actual causative relation made out between the syphilitic infection, which was of very various grades of intensity, and the disease of the ear. Bonnafont assures us that he cured the deafness of these three patients with corrosive sublimate and iodide of potassium, but the second and third cases were certainly not instances of inflammation of the membrana tympani, and therefore, even if they were so cured, it furnishes no proof that they were of a syphilitic nature. In truth, we can only recognise and describe inflammations of the membrana tympani and other diseases in the external and middle ear as occurring in scrofulous, rachitic, or gouty subjects, or in those who have some other dyscrasia ; we cannot, with propriety, speak of scrofulous, gouty, or rachitic disease of the ears. The most frequent causes of disease of the ear are undoubtedly exposure to a cold draught of air, sudden changes from a warmer to a colder atmosphere, the admission of cold water into the ear, catarrhal affections, the exanthemata, scarlet fever, measles, &c., and other fevers, especially typhus.

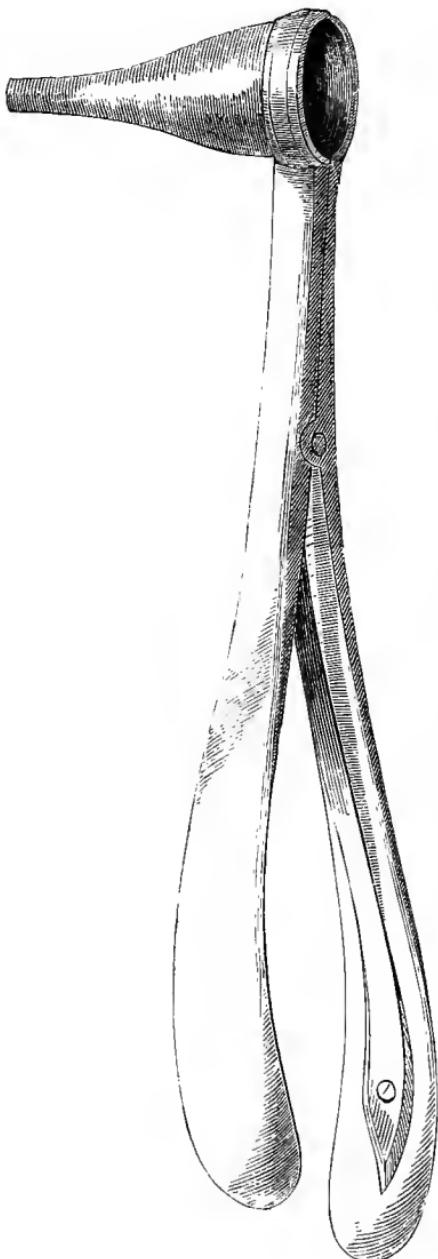
The general custom in England amongst all the better classes of society of washing the head and ears every morning with cold water, of using the shower bath, &c., together with the habit of keeping, even in very cold weather, a window and door wide open, with a large fire in every parlour—these customs, I say, explain the constant occurrence of deafness, with suppressed secretion in the external and middle ear, amongst the English. Several months' practice as an aural surgeon in London has sufficiently convinced me of the truth of this statement. The majority of patients who suffer from disease of the ears are unable even to make a conjecture respecting their origin, and have paid so little attention to the matter that even the time of commencement is wholly unknown. Many date this from the period at which a discharge occurred, when noise in the ears was heard, or some other striking symptom made its appearance ; or when, after they have endured protracted suffering with one ear, the other becomes affected, and the hardness of hearing which has long been present in the one ear now attains such a height as to render ordinary intercourse with the world more or less difficult. Various affections of the system generally, such as disturbances of the functions of the abdominal viscera or of the female organs of generation, &c., are often associated in a genetical relation with the aural disease, but this merely depends on the circumstance that these chronic morbid conditions are coincidently produced during particular periods of development.

The diagnosis of diseases of the ear, that is to say, of those structural changes which produce distinct groups of symptoms, and occur in consequence of some lesion or derangement of the external, middle, or internal ear, rests but very slightly upon the sensations of the patient. Pain, pressure, fulness, noise in the ears, hardness of hearing and the like, are subjective symptoms, upon which but very little reliance can be placed, and the diagnosis must really rest upon those objective and more trustworthy symptoms of which we ourselves can form a judgment in consequence of the easy accessibility of the middle ear. Now, amongst these objective or physical signs we may include those which can be recognised by the eye, ear, and touch, supposing the membrana tympani to be uninjured. By these means we can obtain an accurate diagnosis of the diseases of the external and middle ear, but no objective symptoms are at present known which enable us to distinguish any of the diseases of the internal ear, if we except only carious destruction of the labyrinth.

The objective (or physical) examination of the diseased ear proceeds naturally from without inwards. It commences with the cartilage of the ear, which does not here require particular directions

for its investigation, nor special measures. It is different with the diseases of the meatus and of the membrana tympani; neither of these, on account of the winding course of the former, can be examined without special manœuvres. It is necessary to employ an instrument which will extend the anterior sharp curve of the meatus, and widen its external cartilaginous part, in order to permit the free entrance of light to its deeper portion and to the membrana tympani, and to allow free examination of these parts by the surgeon. The instrument best adapted for this purpose is my aural speculum (see Fig. 1), which I have tried and approved during the last thirty years upon many thousand cases of disease. Any defects it may appear to possess when in use result simply from a want of dexterity on the part of the operator, who introduces or opens it with too heavy a hand. Its length is about six inches, and it consists of a funnel split longitudinally into equal parts, and of two handles, like a pair of pincers, which are connected at right angles, with them. By lightly pressing on

Fig. 1.



the latter the funnel readily opens. The speculum is one inch and two thirds in length ; five sixths of an inch wide at the broadest, and one sixth of an inch at the narrowest part ; its narrow and quite cylindrical extremity is three fourths of an inch long ; and its inner surface is made slightly dull, in order that the reflection of light may not interfere with the examination.

Others have supplied the place of this so-called "awkward" instrument, which cannot easily be put into the waistcoat-pocket, with small, undivided, highly polished specula of different sizes, but by those instruments the absolutely indispensable expansion of the outer part of the meatus cannot be accomplished, and there is consequently no possibility of examining at one glance the whole surface of the membrana tympani. The chief advantage which is said to belong to these small specula is that, when they have once been introduced into the meatus, they remain there, and do not require the hand of the operator, so that he has both his hands at liberty to perform any operation on the ear. Now, this is completely illusory, for there are no operations which require the use of the speculum and of both hands at the same time. Those polypi only which project from the orifice of the meatus, so as to become visible and easily accessible, are fit to be removed by the knife, scissors, or ligature ; small, flat polypi which are only perceptible by means of the speculum, can be destroyed by caustics, and these can be applied with perfect facility with the right hand alone. We place the patient with the affected ear turned towards the light, which may either be that entering through a large window or may be derived from some artificial source. The upper part of the ear is now firmly grasped with the finger and thumb of the left hand and the cartilage pulled upwards and backwards with some force ; the closed speculum is now cautiously introduced into the meatus, as deeply as its width will permit without pain to the patient ; the handle of the instrument is now lightly pressed so as to open the speculum as far as can be painlessly accomplished. When the external ear of adults is healthy, the daylight penetrates easily to every part, so that we can readily recognise the shining membrana tympani, and roughly determine the presence or absence of any organic disease ; but if we wish to ascertain some particular point, to discern some peculiar diseased condition in or on these parts, the direct admission of sunlight into the ear is indispensable. Von Troeltsch is completely in error when he says that "sunlight" is too brilliant. No alterations of colour, no structural changes in the

inner part of the meatus and membrana tympani, can be recognised without the light of the sun, nor can any important therapeutical measures be determined on, nor any operation performed with certainty unless the rays of the sun brilliantly illuminate the bottom of the meatus. For this reason the residence of an aural surgeon should be in such a situation that it may receive the direct light of the sun for some hours, at least, of the day, and that he may consequently make use of it for the investigation and treatment of aural disease. In case of necessity we shall often find sunlighted windows in the houses of patients. But unfortunately there are many days, especially in winter, during which the sun never shines, so that we are either compelled to give up the investigation and treatment of the inner part of the meatus and membrana tympani or to examine these parts by means of artificial illumination. Waxlights and the flames of Argand, photogen, or gas lamps, are much less serviceable, even when increased by concave mirrors and doubly convex lenses (as in Bonnafont's ooscope), than the direct light of an unclouded sky; so also the perforated concave mirror, reflecting the light "of a white cloud or of a white wall," recommended by V. Troeltsch, furnishes, indeed, a white, yet only a very dull, light, by no means sufficient for the certain recognition of deeply seated disease of the membrana tympani or meatus. Moreover, white clouds only occur when there is sunshine, and therefore, in obtaining the latter, all difficulty is removed; besides, in bad winter days there are no "white clouds," so that in this protracted and gloomy period of the year, when we are referred by V. Troeltsch to the reflection of light from white walls, we should probably find them admirably adapted for the magic lantern, but of no service in revealing the conditions of the diseased membrana tympani.

The photogen lamp of Mitscherlich, recommended by Voltolini, through the flame of which a stream of oxygen is conducted, is, however, well worthy of notice; the light produced in this way is very white and clear, yet is not equal to that of the sun, nor does it enable us to ascertain with certainty the nature of the more delicate structural changes occurring in the deeper parts of the meatus or in the membrana tympani, as I have satisfactorily convinced myself, by using the flame of a large apparatus, in the laboratory of Mitscherlich. We can endure its brilliancy without shading our eyes, but who can, with impunity, look at the sun? It must be remembered also that the combustion of oxygen in the photogen flame is not quite free from

the danger of an explosion. Only the light of the oxyhydrogen apparatus and the electrical light can supply the place of the sun, but these have not been adapted for practice, nor have any sufficiently cheap forms of apparatus been constructed to bring them into general use.

We consequently maintain that the direct light of the sun, with the use of the speculum, is indispensable for the diagnosis and treatment of the diseases of the external ear, especially of those of the tympanum.

The examination of the soft palate and of the pharynx, as of the parts in the immediate vicinity of the guttural opening of the Eustachian tube, can be effected by the patient making a deep inspiration with his mouth wide open, and then holding his breath, by which means the root of the tongue is drawn downwards and backwards, and the soft palate, on the contrary, upwards, so that we are only occasionally obliged to hold the tongue down with the handle of a spoon or other flat object.

Voltolini shows how to bring into view the œsophageal opening of the Eustachian tube in the following way (rhinoscopy).^{*} Whilst the velum is raised by a deep inspiration, it is to be pressed upwards as far as possible by means of a wire loop; then the pharyngoscope is to be passed quickly into the throat, and the light of his photogen lamp (with a cylindrical wick of $1\frac{1}{4}$ " in diameter) directed upon the pharynx, in order to illuminate the œsophageal opening of the Eustachian tube. Voltolini may, indeed, have demonstrated the practicability of this complicated procedure to his colleagues of Breslau, but very few patients possess the strength of will and the insensibility of the velum palati which are indispensable in order to allow such a method of research to be carried out. Fortunately, the œsophageal opening of the Eustachian tube is seldom or never the seat of diseased conditions which are not equally well marked in the mucous membrane of the œsophagus. To this optical means of diagnosis the tube, in its whole extent, and the tympanic cavity when the membrana tympani is entire, is, of course, wholly inaccessible. Acoustic means must here be employed. These consist of blowing air with the mouth through aural catheters of various calibre into the Eustachian tube with the use of the diagnostic tube; this is again to be followed by the introduction of catgut bougies through the Eustachian tube, in order to complete the acoustic diagnosis of the diseased conditions by symptoms derived from the sense of touch.

* For details on this subject, the reader may consult Czermak's 'Monograph,' p. 25, New Sydenham Society's Translation.—TRANS.

Fig. 2.

No. 1.

No. 2.

No. 3.

No. 4. No. 5.



For the catheterism of the Eustachian tube my cylindrical and inflexible silver catheters are best adapted (see Fig. 2). They are six and a half inches in length, with a beak bent laterally for three quarters of an inch at an angle of 144° , to suit the position of the oesophageal opening of the Eustachian tube. The proximal extremity of the catheter expands into a funnel-shaped dilation of three quarters of an inch in length, to which is attached an oval ring, on the same side as that to which the beak is bent; by the position of this we are enabled to judge of the position of the beak when it has been introduced through the nasal meatus.

Catheters made of gutta percha (Rau) should never be employed, because they cannot be kept so thoroughly clean, nor be manufactured of such uniform and, at the same time, various sizes as those made of silver.

For the thorough acoustic investigation of the middle ear, we make use of four catheters, gradually increasing in size, on blowing through which we are able to obtain a succession of streams of air, which whilst they gradually increase in force, can at the same time be constantly maintained of equable strength (see Fig. 2; the numbers 1—4 indicate the sections).

No. 1 catheter corresponds to the diameter of No. 1 of Charrière's draw-plate (*filière*), well-known to all instrument makers; it will scarcely admit the entrance of a common pin. No. 2 catheter corresponds to No. 3 of the draw-plate, and is quite equal to the diameter of the healthy Eustachian tube at its narrowest part, which is at the point of union between the osseous and cartilaginous portions. Catheter No. 3 has the width of No. 6. No. 4 catheter has the width of No. 7 of the above-mentioned draw-plate. No. 5 catheter has the same curvature at its beak, but is about 5" longer, and serves for the catheterism of the Eustachian tube through the nasal meatus of the opposite side, when circumstances prevent the passage of a catheter on the same side of the nose. It is useless to divide the catheter into inches and lines, and we have long considered Itard's proposal unpractical, which consisted in endeavouring to ascertain, before using the catheter, the distance of the oesophageal opening of the tube from the entrance of the nasal meatus, by measuring the distance of the base of the uvula from the upper incisors.

As a rule, the catheterism of the Eustachian tube should be accomplished with one of the catheters 1—4, introduced through the corresponding nasal meatus of the ear that is to be examined. For this purpose the patient, if an adult, is to be placed upon a chair with

a common back, or with one somewhat higher than usual, in order that the head may be supported. Children between the ages of eight and fourteen should be placed with their back against a grown-up person, who may support them, or, if reliance can be placed on their steadiness, against a wall, a table, &c. Younger children should be taken on the lap of an intelligent person, against whose breast they can lean their heads. This person should keep the legs of the child between his thighs and hold his hands, whilst the head of the child is fixed by the left hand of the surgeon. These measures are very necessary, as children are often restless and unruly.

After the patient has blown his nose (partly for the purpose of clearing away a too abundant secretion, partly, in case the nose is too dry, to moisten it, and thus enable the instrument to slide along it with greater facility), we dip the catheter into pure olive oil, and blow through it, to assure ourselves of its permeability ; the head of the patient is then fixed with the left hand ; the catheter is held with the thumb and finger of the right hand close to the funnel-shaped extremity, in such a manner that the ring attached is turned downward ; the beak is placed in the nasal meatus, resting upon its floor, close to the septum, with the convexity upwards. From this point it is pushed backwards with a very light hand, sweeping as much as possible along the floor of the nostril, with continual elevation of the handle, till the instrument becomes horizontal and its extremity rests against the posterior wall of the pharynx ; the thicker the catheter, the more easily are these movements executed, on which account I am accustomed to use the No. 3 catheter for the first operation, even in young children.

Sneezing is rarely induced, if we do not keep the beak of the instrument too long in contact with the external entrance of the nasal meatus.

Irregularities in the form of the inferior turbinate bone and strong lateral displacement of the septum may render the first introduction of the catheter very difficult, and test severely the delicacy of the sense of touch in the hand of the operator. As the point of the beak arrives at the posterior wall of the pharynx, the funnel-shaped end of the catheter is to be raised a little above the horizontal line, and at the same time to be lightly withdrawn ; the beak then sinks and rests upon the posterior wall of the soft palate, which at that instant contracts, performs a swallowing movement, raises itself, and, when assisted by a quarter turn upon its axis from within outwards, lifts the beak of the instrument into the tube.

If this rapid movement is not successful in the hands of an inexperienced person, the beak of the catheter must be conducted back to the upper part of the pharynx, in order that it may be slowly drawn forwards and turned at the same time laterally a quarter-turn upon its axis towards the outside, by which means the ring upon the funnel-shaped end is directed horizontally. It now slides over and into the swelling of the tube itself, where the beak of the catheter is directed, with its concavity against the anterior swelling of the tube, and here it hooks into it, and can be clearly felt to be grasped by it upon quickly withdrawing it. The catheter lies here quite conveniently, being in no way a source of annoyance to the patient, even in speaking, in swallowing, or in any of the movements of the head. For the sake of security, we now slightly elevate the beak of the catheter above the horizontal line, directing it upward and outward, the position of the beak being determined and rendered evident by the direction of the ring upon the funnel-shaped end.

If, in consequence of impassability of the corresponding meatus, we are compelled to introduce the catheter into the Eustachian tube from the other side of the nose, we pass No. 5. catheter, which is about equal in diameter to No. 3, in accordance with the above directions, quite to the posterior wall of the pharynx ; gently turning it inwards, we withdraw it to such a distance that it touches the velum palati ; and then, during the strong elevation of this which immediately follows the lateral quarter turn of the catheter upon its own axis towards the affected ear of the opposite side must be accomplished with a sure and steady hand, because there is barely room for its prolonged beak. Hence this manœuvre cannot, in general, be performed without some degree of discomfort to the patient. If, however, it be effected, the beak is firmly grasped, sometimes so firmly that some difficulty is experienced in withdrawing the catheter. As a rule, the removal of both the ordinary and of the elongated catheters is best accomplished by performing the same movements as those which effected their introduction, only in an inverted sequence. The catheter being in position, we now place in the meatus of the patient's affected ear one end of a tube, made of vulcanized India rubber, a quarter of an inch in diameter, and about two feet in length, which is provided with a funnel-shaped extremity. The opposite end, which is also conical, is firmly fixed in the meatus of our own ear. This tube can be kept in the ear of the patient, either by himself or by some bystander. This done (and it may be accomplished before the introduction of the catheter, if preferred), we blow

Fig. 3.

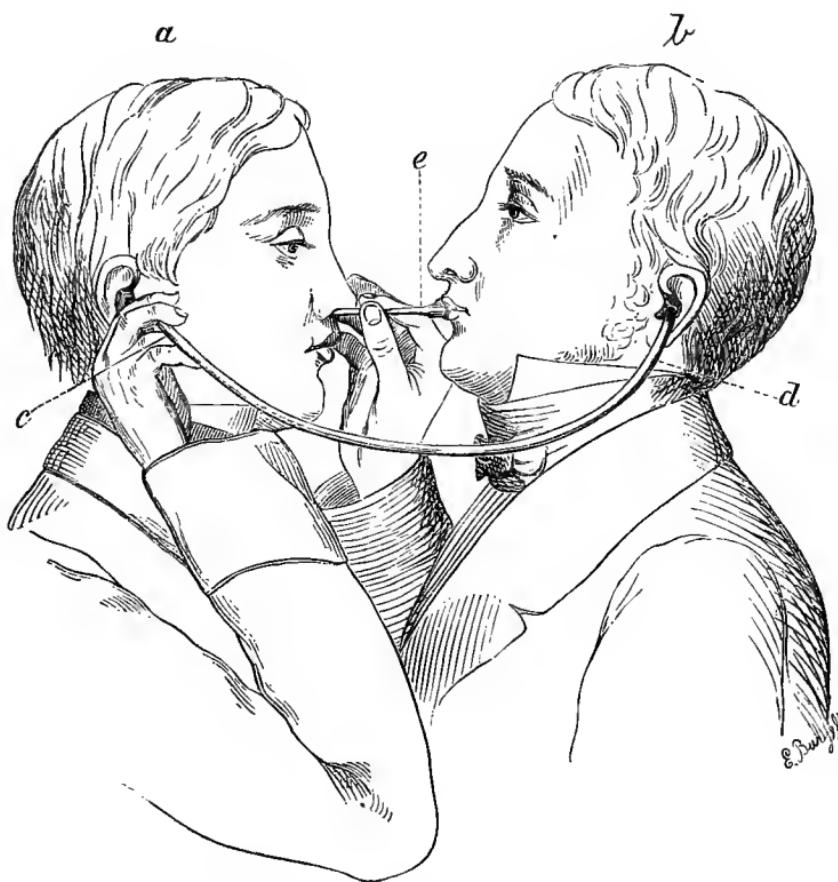


Fig. 3.—*a.* The patient. *b.* The surgeon. *c, d.* The India-rubber diagnostic tube. *e.* The Eustachian catheter.

through the catheter, which is kept steadily fixed in the Eustachian tube with the right hand, cautiously increasing the pressure of the air (not using any caoutchouc bag, bellows, or air-press, either large or small) (see Fig. 3).

If the passage of the middle ear be completely free, the air appears to pass through it, and to penetrate into the diagnostic tube fixed in our own ear, which we may briefly indicate by the expression *the air passes freely*.

This important acoustic symptom presents different characters according as there is diminished permeability of the Eustachian tube, diminution of the cavity of the tympanum, increase or diminution in the amount of secretion from both these parts of the organ, and,

finally, after the protracted employment of catheters, the size of which has been gradually increased in diameter, as from 1 to 4. It thus leads to an objective knowledge of the various organic changes of the normal structure and secretion of the tube and tympanic cavity, as will be further shown in the description of the diseases of the middle ear. The physical characters of these acoustic symptoms are far more clear and distinct than those which present themselves when the stethoscope is used for the diagnosis of the diseases of the respiratory organs. Here, in order to obtain certain acoustic signs, the respiratory activity of the patient is indispensable, whilst this mode of examining the middle ear enables us to accomplish everything without any co-operation on the part of the patient. If we find, on blowing into the Eustachian tube, any obstacle to the transmission of air into the tympanic cavity, we may conclude there are contractions in the former, the position, extent, and tightness, of which may best be ascertained by the introduction of a catgut or elastic bougie. For this purpose the finest harp or lute string about one sixth millimetre in diameter should be employed. This should be pushed into catheter No. 2 till it just appears at the end, and a mark made upon the catgut, indicating the length of the catheter; then additional marks should be made with ink at distances of one inch, half an inch, and again another half inch, from the first. These indicate respectively the distance of the point of union of the cartilaginous and osseous portions of the tube, the opening of the tube into the tympanic cavity, and, lastly, the transverse diameter of the tympanic cavity, measured from the oesophageal opening of the tube. Provided with this catgut, No. 2 catheter is passed into the Eustachian tube, and the end of the catgut, about half a millimetre in diameter, being slightly bitten, so as to soften it, is to be slowly passed along the catheter, which may be fixed by the right or left hand. Catheter No. 2 has so small a calibre that, though it easily permits the passage of the catgut, yet this retains, on emerging, the curve of the beak, and it has never occurred to me to slip the catgut down into the throat, but it has always entered the tube with certainty.

The patients frequently complain, when the catgut is pushed onward, of more or less acute stabbing pain in the neck, in the region of the ear, which must not mislead us if we are only certain of the right position of the catheter in the tube.

If there be a contraction in the Eustachian tube, to which the catgut reaches, but will not pass, we should then wait a few minutes, and upon renewing the pressure we may, perhaps, succeed in passing

through it, the patient experiencing at the same time more or less acute pain ; the catgut then passes on readily, unless there should be another constriction at a greater or less distance from the first. The marks on the catgut enable us easily to determine the distance of the contraction from the cesophageal opening, of what extent it is, how light, and other points of importance. My elastic bougies commence with a diameter of a quarter of a millimètre and increase very gradually in size, the difference never being more than one-twentieth of a millimètre. These must be introduced through catheter No. 3 ; the markings of the above-mentioned distances upon the bougies can be made with white oil colour. Bonnafont has strongly recommended for this purpose filiform bougies of caoutchouc, half, one, and one and a half millimètres in diameter, which are to be forcibly pushed through the constriction ; this, according to his own statement, produces much pain, but is followed by very good results. But if we reflect that there is often considerable difficulty in passing a constriction with a catgut bougie of one sixth of a millimètre in diameter, we can hardly comprehend how bougies from three to nine times thicker (half to one and a half millimètres), can be made to force a passage. Caoutchouc bougies possess this great disadvantage—that they cannot be made so soft at their points as a well-chewed piece of catgut, so that they often inflict an amount of injury upon the diseased and always very irritable mucous membrane of the tube, which may be followed by serious consequences.

In opposition to this acoustic, tactile, and decidedly objective method of examining the middle ear, now for the first time published, stands the so-called Valsalva's experiment. This consists in a strong expiration being made by the patient whilst the oral and nasal orifices are closed. Its success depends as essentially upon the intelligence of the patient as upon the skill and judgment of the surgeon, and it therefore possesses a completely subjective and consequently very uncertain character. Now, I say, that in this experiment the patient only perceives in one or both ears a slight feeling of pressure, with an equally weak, crackling sound, which may also be heard by the surgeon if he place his ear against that of the patient or uses the diagnostic tube. Wilde describes this faint noise as "a sort of *thug*," which he considers, with Toynbee, Erhard, and others to be a satisfactory proof of the complete absence of any obstruction in the middle ear, but in which, as a means of diagnosis, it requires a very lively imagination to discover any value.

The diseases of the internal ear are unfortunately completely inac-

cessible to our physical method of examination, and we must therefore endeavour to remedy this deficiency partly by negative, and partly by functional symptoms. Hitherto all such attempts have been fruitless, but at a future page we shall have the opportunity of entering more fully upon these important circumstances when treating of the diseases of the middle ear. The majority of the diseases of the external and middle ear are essentially inflammatory, and the inflammation has a great tendency to become chronic. To what extent this is true, in regard to the parts constituting the internal ear, has not yet been satisfactorily determined by dissection, and much less, therefore, during the life of the patient. At all events, there are neither pathological nor anatomical data from which we can at present positively assert the existence of the "frequent dangerous and even fearful rheumatic inflammation of the labyrinth, and of the auditory nerve in particular" of Erhard.

Diseases of the ear are exceedingly common, probably even more frequent than diseases of the eye, as may be calculated from the great number of the deaf and dumb. In 1856 there were in Prussia 13,297 deaf mutes, and 10,206 blind, which numbers are in the proportion to the whole population of 1 deaf mute in 1109, and 1 blind in 1738. The opposite opinion is the more natural one, because the affections of the eye, and their consequences, are in every way more obvious than those of the ear, whose troublesome accompaniment, deafness, is infinitely less apparent.

The numerical proportion between the diseases of the ear in males and females is in favour of the latter, and is naturally to be attributed to their being much less liable to injurious influences, from the quiet nature of their ordinary avocations.

It is worthy of remark that the greater number of affections belong to the middle ear (560 in 1000), whilst the apparently much more exposed external ear, including the delicate membrana tympani, is much less frequently affected (427 in 1000). The number of cases of undoubted disease of the internal ear is extraordinarily small (13), the great majority of which consist of nervous hardness of hearing and deafness. (See the above Table, p. 17.)

Some few diseases of the ear commence with an acute stage, but even these have a strong tendency to become chronic, and thus assume the general character of all aural affections. Pain, and especially fever, are symptoms of rare occurrence, and must be rather attributed to the fault of the patient himself, since they are induced essentially by neglect.

Diseases of the ear are seldom dangerous to life, and then only indirectly, by the extension of inflammation from the internal or middle ear to the dura mater, brain, or cerebellum.

The prognosis of diseases of the ear is generally very unfavorable, partly on account of their gradual and imperceptible approach, commencing first in one ear only, partly on account of the concealed position of the affected parts, which are accessible only to the educated hand. The numerous exceptions which fortunately occur to this general rule shall be duly noticed in the subsequent sections of this work. As regards treatment, it is of little importance to determine the nature of the primary cause, nor does the investigation into the constitutional affections which accompany the aural disease (as plethora, anaemia, amenorrhoea, abdominal disease of any kind, nervous debility, &c.) prove of much service in enabling us to arrive at an early and accurate diagnosis ; if we therefore make the treatment and cure depend upon the discovery of such constitutional symptoms, much valuable time will be lost that might have been more advantageously employed ; and hence, though it may be very important to combat the general symptoms with the most active means at our disposal, we must not expect to make much impression on the aural disease, and should not hesitate for a moment to adopt local remedies in addition to the general or constitutional treatment. The immediate causes of aural disease do not present anything definite for consideration in a therapeutic point of view ; their operation, even in recent cases, as when they have been produced by exposure to cold, has long ceased before surgical interference is demanded, whilst in the majority of chronic cases all knowledge of their real cause is completely lost.

In each form of disease that which it is of primary importance to ascertain, in order that appropriate treatment may be adopted, is a knowledge of the material changes which the solid parts of the external, middle, and internal (?) ear have undergone. In a word, the treatment of aural affections, whether the general health of the patient be affected or not, is essentially *local*. Whence it follows that we are never, in any case, to regard what are really only symptoms of disease, as hardness of hearing, noise or pain in the ear, or discharge or dryness of the meatus, &c., as independent diseases, nor as the objects of treatment by the so-called specifics, glycerine, Pinter's ear pills, ear oil, blisters, the application of the constant or induced electric current, &c.

SECTION II.

SPECIAL SURGERY OF THE EAR.

THE division of the diseases of the ear in accordance with anatomy, into those of the outer, middle, and internal ear, is thoroughly consonant with experience, especially if, with such a division, we enter upon a consideration of their different elementary parts; for the various forms of disease which present themselves not only differ from one another by characteristic groups of symptoms, but exhibit also a great tendency to independent progress and a corresponding indisposition to extend themselves to the adjoining structures or to complications of any kind. The latter are most frequently the consequences of destructive processes which have taken place in the delicate membrana tympani, whereby the more deeply seated and important parts are deprived of their natural protection, and become liable to injury, which is, in truth, a far more frequent cause of their disease than the extension of chronic inflammation from the perforated membrana tympani.

CHAPTER I.—DISEASES OF THE EXTERNAL EAR.

According to the above Table, p. 17, these are next in frequency to the diseases of the middle ear. They would probably exceed them in number if the diseases of the cartilage generally, instead of only exceptionally, fell under the care of the aural surgeon, for the cartilages are, as is well known, often implicated in the exanthemata and other febrile affections and in chronic skin diseases, and the hearing is not unfrequently also affected.

The nature of the diseases of the external ear can, in general, be readily investigated by the eye of the surgeon, whilst it requires but little manipulative skill to apply an appropriate local and effective

treatment. A favorable prognosis may therefore, in general, be given, especially since the symptoms of the various forms of disease, as swelling and discharge, are singularly patent, whilst the pain and the well-marked functional disturbance which accompany their sudden onset call the attention of the patient to their presence at a very early period.

DISEASES OF THE CARTILAGE OF THE EAR.

These diseases, as long as they are limited to the cartilage, and do not affect the meatus, are of little importance to the ear as an organ of sense, especially if one side only be affected. Since the part which the auricle normally plays in the concentration of sound, is not materially affected by such affections, though the patient may find them sufficiently troublesome and annoying in his ordinary pursuits, in the following descriptions I have distinguished between inflammations of the dermis, connective tissue, and perichondrium, but I have omitted simple erythema, because, in the first place, it is in itself exceedingly unimportant, and secondly, because it is altogether lost in the far more serious character of the exanthematous affection with which it is associated.

Inflammation of the Dermis of the Auricle.

(A) *Acute form.*—Acute inflammation of the dermis commences with more or less fever, pain in the head, coated tongue, loss of appetite, and a general feeling of illness; sometimes there is a sensation of heat, extending to the neighbouring cheek, with itching, redness of a livid colour, tension, and swelling, which causes the elevations and hollows of the auricle to disappear, and the meatus to become, more or less, occluded. Sometimes even the membrana tympani is inflamed, and the inflammation spreads from thence over the dermis of the auricle. These last cases are always accompanied by hardness of hearing, and sometimes by noises in the ears. The swollen, dark-red auricle is often covered, on the first or second day, with vesicles containing yellowish serum, or with larger bladders, which, after a few days, burst, and dry up into thin, blackish-gray crusts. About this time, or, at latest, on the fifth day, the inflammatory appearances just described gradually decrease in the auricle, whilst they slowly extend over the cheek, nose, forehead, and the skin of the head, even as far as the other ear; here, finally, in the same manner as in the ear first

affected, the symptoms disappear, with marked remission of the general febrile disturbance, about the ninth day of the attack. If the meatus and membrana tympani be implicated a thin discharge takes place from the former as soon as the inflammation commences in it, the cure of which presents no peculiar difficulty as soon as the inflammatory swelling of the auricle and that of the meatus are subdued.

Cold, the stings of insects, exposure to the sun, gastric irritation, mental excitement, &c., are the most frequent causes of this form of disease, which in itself is by no means dangerous, unless, from great neglect, it should extend to the membranes of the brain. It is only in very cachectic subjects that the inflammation attacks the perichondrium, with a tendency to destructive and foetid suppuration of the auricle.

With the exception of the last two cases, which are very rare, inflammation of the dermis of the auricle, as a rule, runs a favorable course, and its short duration, with the absence of important disturbances in the function of the ear, constitute the chief reasons why these acute inflammations so seldom come under the care of the aural surgeon.

The prognosis, if ordinary care be taken by the patient, is very favorable. The inflammation runs its course completely in nine days, the auricle desquamates, and returns to its original form, the meatus again opens, and the inflammation of the membrana tympani soon yields to mild antiphlogistic treatment.

The life of the patient is only in danger when the inflammation extends to the membranes of the brain. The treatment consists, in the first place, of the negative duty of avoiding exposure to cold, moist air, and secondly, in attention to the accompanying febrile condition. The patient should remain in bed, or in a warm room, take sops, or mild warm drinks which favour perspiration, with cooling aperients; after which, perhaps, an emetic may be requisite.

Inflammation of the dura mater, with foetid suppuration and destruction of the auricle, must be treated in accordance with the general principles of surgery, and need not here be discussed.

If, after the inflammation of the dermis has run its course, any inflammation of the dermis remains, with muco-purulent discharge, it may very soon be removed by the daily injection of warm water into the ear, and the subsequent dropping in of a few drops of warm olive oil, or of a warm solution of sulphate of zinc (gr. i—iiij in Aq. 3j.)

(b) *Chronic form*.—Redness and swelling occur without any febrile symptoms or constitutional disturbance, but with some burning and itching in one or both ears, occasionally extending to the meatus or to the adjoining part of the cheek, which is soon covered with little vesicles, whose serous or purulent contents dry up into crusts and scales of various extent, thickness, and colour. In old cases, and in very unhealthy constitutions, very painful burning cracks form in the tense, dark-red, shining skin of the auricle, the secretion from which sometimes becomes very offensive and irritating. Where the necessary cleansing of the parts has been neglected, where the diet has been bad, or where some form of cachexia is present, the inflammatory process insidiously extends to the connective tissue and perichondrium, producing knobby thickening, cancroid degeneration, fetid suppuration, and partial destruction of the auricle (cancer of the ear, elephantiasis, lepra), on the occurrence of which, fever of a typhous character may supervene and lead to a fatal issue. I remember a case in which the remarkably thickened and discoloured cartilage of the left ear was converted into an extensive ulcerated surface, without any trace of its original structure. It was covered with fetid pus, and surrounding it was a groove nearly an inch in breadth and of equal depth, with hard livid edges, filled with similar dark stinking pus. In this case, in spite of the violent burning pain and the insufferable odour which the irritating purulent secretion spread around the patient, he had endeavoured for two years to cure himself with ordinary domestic remedies.

If the inflammation of the dermis extend itself to the corresponding membranous layer of the meatus, with more or less occlusion of the passage, hardness of hearing, and noise in the ears accompany it as soon as the membrana tympani becomes affected.

When the inflammation subsides in cases that are not very serious, the violent itching in the skin diminishes, the formation of fresh vesicles on the surface ceases, cracks and clefts dry up, scabs separate and fall off, leaving behind them a very sensitive, thin, shining, red cuticle, which, after the lapse of some weeks, assumes the natural hardness and colour; the meatus again becomes pervious, and the normal power of hearing is then restored. Cancerous and nodulated, passing into ulcerative degeneration of the auricle, does not admit of a return to a healthy state. The course of this inflammation is extraordinarily protracted, lasting for months, for years, or even through the whole life of the patient; and it may almost always be considered

as connected with a more or less strongly-marked scrofulous diathesis, which, when combined with bad food, want of cleanliness, unhealthy locality, improper local treatment with strong irritants, &c., causes the disease to assume an exuberant, ill-conditioned, and destructive character.

The prognosis is by no means unfavorable if the chronic inflammation have not yet produced any remarkable degeneration, exuberant growths, suppurative destruction, &c., and the constitutional disorder be capable of improvement. The treatment must be essentially constitutional, and directed to the general condition of the patient. Fat, acids, farinaceous food, and, in general, all food difficult of digestion, should be excluded from the diet of these cachectic patients. They require strong, nourishing aliment, both fluid and solid.

It is indispensable that the bowels should be kept freely open, but in cachectic individuals this should not be allowed to pass into diarrhoea. Either artificially made baths, or those especially of Kreuznach, Nauheim, and similar places, should be taken, and, at the same time, the use of the Adelaide and Eliza springs, of whey, of iodide of potassium, &c., are especially to be recommended. If these means should fail, we may employ, if the patient's strength will permit, Fowler's solution of arsenic, in doses of from two to four drops, two or three times a day, a quarter of an hour after meals. The local treatment consists in carefully removing and drying up the diseased secretion by means of a soft sponge dipped in warm water, and subsequently powdering the surface with the semen lycopodii. If the itching and burning be very severe, soft lint dipped in a warm solution of sulphate of zinc (gr. ii—iv ad $\frac{3}{4}$ j), should be placed upon the ear. Thick, hard, purulent scabs are softened with great relief to the patient, by the application of warm bread or linseed meal poultices. Ointments and oily applications are in general of little or no service. When the chronic inflammation of the dermis has proceeded to the formation of nodulated, cancerous degeneration, or purulent ulceration, its treatment comes under the care of the surgeon, who may restore the patient to a tolerably satisfactory condition by the removal of the indurated auricle.

Inflammation of the Connective Tissue of the Auricle,

commences with more or less acute tensive pain, which is accompanied by the formation of an apparently well-defined, pale-red swelling of small size, upon the external surface of the auricle. With suitable treat-

ment relief is soon obtained, the little abscess bursts, and discharges laudable pus streaked with blood. In a few days it heals up, and leaves no mark. As a rule, only one ear is attacked, and neither hardness of hearing nor any constitutional disturbance accompanies this trifling ailment.

We are unable to assign the causes which give rise to this inflammation of the connective tissue, which is, upon the whole, a somewhat rare disease.

The treatment requires only the application of very warm emollient poultices of linseed meal, renewed every half-hour until fluctuation is perceptible. After bursting, a free discharge takes place, and there is no subsequent induration, the small purulent cavity closes up in a few days, without further assistance, and so terminates this light but still characteristic ailment.

Inflammation of the Perichondrium.

This presents essentially different characters, according to the general state of the patient's health. In strong constitutions a bright-red swelling arises upon the external surface of the auricle, with acute, tensive pain. It increases till it attains the size of half a hen's egg, and fluctuation can be perceived in it at an early period. Some febrile symptoms are present, but they never become very acute. If the tumour, which is slow in bursting of itself, be opened with a lancet, we find effused between the perichondrium and the cartilage a dark-coloured bloody fluid, which soon collects again, making it necessary to repeat the incision, until at last suppuration takes place in the cavity. After the lapse of some weeks this closes up, without leaving any deformity of the auricle.

In debilitated individuals, on the other hand, especially in the imbecile and melancholic tenants of madhouses, a tumour usually develops upon the anterior surface, and most frequently upon the upper half of the auricle of the left ear. It attains the size of half a hen's egg, or more, so that it even occludes the meatus. It is bluish-red, convex, slightly undulating on the surface, tense, painful on pressure, and even from the commencement, though only obscurely, fluctuating. When laid open, thin venous blood, which has been effused between the perichondrium and the cartilage, is discharged.

If it be only of small size, all tension will disappear spontaneously in a few days, the tumour becoming soft, pale, and continually diminish-

ing, even if it be unopened, in consequence of absorption of the effused blood. If it have attained a remarkable size, fresh cartilaginous tissue is deposited in the form of larger or smaller islets upon the inner surface of the perichondrium, where it has been separated from the cartilage, the union of which with the original cartilage of the auricle, and with the thickened and relaxed integuments, produces a strange kind of deformity.

Three or four weeks are required for its cure; sometimes the whole process is repeated in the other ear, sometimes both ears are attacked in the same manner at the same time, though this has only rarely been observed. In some few instances, after complete recovery from one attack, the disease has recurred in the same ear.

The causes of these bloody tumours on the cartilage of the ear are unknown, though we must admit that they are especially likely to be produced by violence (blows on the ear), which perhaps explains their more frequent occurrence on the left ear.

If the inflammation of the perichondrium have developed itself in a strong constitution, with synocha, we must recommend rest to the patient, with cooling diet, mild aperients, and locally cooling and dispersive applications of lead lotion. The necessity of surgical interference with the tumour must be determined by its size, and the presence or absence of fluctuation. Some very plethoric persons may require to be bled.

In cachectic and debilitated subjects the tumour should be laid open at an early period, even though the sense of fluctuation be obscure, the effused blood thoroughly pressed out, and the tumour covered with stimulating applications of warm aromatic tinctures. The use of these should be continued till the cure is effected. Good nourishment, easily digestible food, good port wine, invigorating and tonic medicines and baths, residence in pure warm air, and moderate exercise, essentially further the process of healing, and prevent relapses.

The personal attendants of the insane should carefully watch them, in order to prevent them from injuring themselves.

DISEASES OF THE MEATUS.

These may be divided very characteristically into inflammatory irritation of the cuticle, inflammation of the dermis and connective tissue, and of the periosteum of the meatus. Bonnafont is quite in

error, as may easily be deduced from our description of these forms of disease, in declaring that it is impossible to distinguish between inflammation of the dermis and of the connective tissue. In accounts of the diseases of the meatus we frequently meet with the striking error that this passage possesses no mucous membrane, and is only protected by a cuticle, and that in healthy conditions no kind of secretion is observed in the meatus except cerumen.

The inflammatory diseases of the various layers of the integument of the meatus have, even when strongly marked, when of long continuance, and when much neglected, little, if any, tendency to run into one another. The only exception to this rule is periostitis, whose consequence—caries of the osseous meatus—generally induces inflammation of the dermis.

Inflammatory irritation of the Cuticle and Ceruminous Glands.

This affection often commences with a somewhat severe dragging or tearing sensation in one or both ears, with pain in the head, neck, and jaws, or it may be associated with very severe catarrhal symptoms; generally, however, there is such slight inconvenience that it is soon forgotten by the patient. It either very quickly attains a high degree of intensity, or else, gradually increasing in severity in the course of a week or two, fulness, dulness, and, in many instances, difficulty of hearing and noise in the ears are developed. Whether these last are continuous or intermittent symptoms, whether they are relieved by yawning, lateral movements of the jaw, or strong pulling of the auricles; whether the immediate vicinity of the ear be insensible, as is often the case, or not, is a circumstance to which no attention need be paid, for the diagnosis is determined by other and more certain means. There is no constitutional disturbance, and any present or previous disorder which the patients may state they are or have been suffering from, in their enumeration of commemorative symptoms, will be found, on close inquiry, to be wholly independent of the aural disease. If we examine the affected ear with bright sunshine and the speculum (with both of which we may often dispense in the case of adults), we discover, sometimes only in the deeper parts, sometimes nearer the entrance, filling up the meatus, dark-brown or even black, hard or soft, shiny masses of cerumen clinging together. Subjacent to these the integument of the meatus is often reddened, or even excoriated, and very tender. The mem-

brana tympani, after the removal of the ceruminous masses, always appears dull, but little translucent, and here and there strongly injected, especially along the line of attachment of the handle of the malleus. Out of about 800 cases, some of which have been of long standing, I have never observed any disorganization of the membrana tympani, or of the meatus (perforation, caries, &c.), and it must, therefore, be admitted that these degenerations have only been ascribed to mechanical pressure and inflammation, produced by collections of acrid and depraved cerumen, because the diagnosis of these masses from dry pus scabs was not known ; the latter being often found in the deeper part of the meatus, in cases of neglected caries, and chronic inflammation of the perforated membrana tympani. The greenish colour, and foetid odour of these pus scabs when dissolved in warm water, very easily distinguish them from old and hardened masses of cerumen. It is only in very rare cases that we find the meatus apparently completely filled up with soft cerumen, and yet no diminution in the power of hearing, either for vocal sounds or for the movements of a watch ; in such cases we can only conclude that the cerumen does not wholly occlude the passage, so as completely to prevent the entrance of the waves of sound, for it is observable that in those cases of greater hardness of hearing which are usually associated with such collections of wax, the patient can be immediately relieved by passing a blunt silver probe through the mass until it is close to the tympanum, so that after its withdrawal a passage, if only a small one, is left to conduct the vibrations of sound, without let or hindrance, to the membrana tympani.

On the other hand, though only occasionally, we do find collections of cerumen as complications of deep-seated diseases of the tympanic cavity, the existence of which is proved by the very slight alleviation of the hardness of hearing which takes place after the complete removal of the cerumen.

In the great majority of cases, both the hardness of hearing and noise in the ears disappear immediately and entirely with the removal of the cerumen, so that we have no room for doubting that these collections exert both an obstructing and an irritating influence upon the membrana tympani. (See above, p. 16).

Immediately after the clearing out of the ears, the patients are somewhat stunned from the violent contrast which they experience in the loudness of sounds. This, however, scarcely lasts an hour, and is not even remotely to be compared with the extreme sen-

sibility of the retina after the operation for cataract, which requires to be very cautiously and gradually accustomed to light.

The hardness of hearing by which collections of cerumen are accompanied, is usually very well marked ; so that for instance, a watch, the normal hearing distance of which is thirty inches, can only be heard at the distance of a few inches ; and we may doubt whether the conduction of sound takes place through the ceruminous masses or the bones of the head. That a more abundant secretion of cerumen may take place, as a result of exposure to severe cold, discovering itself by hardness of hearing and noise in the ears, is perfectly certain, and by no means unfrequent. The increase of the secretion is the consequence of a suddenly increased activity of the ceruminous glands, which again, in its turn, is followed by an erythematous inflammation of the cuticle of the meatus which may be recognised in such, if we may so call them, acute cases, by clefts in the ear, and excoriations of the cuticle.

By far the greatest number of cases of ceruminous collection in my practice have occurred amongst those who pay considerable, though not, perhaps, the most anxious attention to the thorough cleanliness of the ear. I am unable, therefore, to derive it from neglect of cleanliness, and still less from too strong a growth of hair at the entrance of the meatus, since this is rare, and only occurs at an advanced period of life ; whilst these collections are more frequently met with in middle age and youth. If we reflect, moreover, that in consequence of the extreme sensibility of the inner two thirds of the meatus, in which part the ceruminous glands are always distributed, it is impossible to remove anything which has thus collected by means of an ear-pick or other instrument ; we can easily imagine that these collections of wax would be far more frequent, especially amongst the lower classes, than is actually the case if they depended merely upon neglected cleansing of the ears.

The most frequent cause of this disease is the entrance of water into the ears, during river or sea bathing, in our daily washings, cold shower-baths, douches, and the like, for it is impossible to dry the meatus, especially in its inner two thirds : so that the moisture still remaining evaporates, and thus cools the surface. In favorable circumstances this only stimulates the cuticle and the glands lying immediately beneath it, but in unfavorable conditions the deep layer of the skin, the membrana tympani, and even the more deeply seated membrane of the tympanic cavity, are excited to in-

flammation. The operation of bitterly cold and damp air upon the surface of the meatus is exactly similar. Inflammation of the cuticle of the meatus with diseased secretion of cerumen is very frequent; for example, in 1000 cases of aural disease, it occurred 163 times ($=16: 100=\frac{1}{6}$). The cure of this trifling, yet troublesome disease, which may be accomplished so easily and by so many different methods, is a circumstance favorable indeed for the patient, but very unfavorable for the development and improvement of the art of aural surgery. The cure may be effected by many means applied almost at random, and purely empirical in their nature, as by oils of all kinds, drops, injections, fomentations, vapour baths, sea water and other baths, in which the water easily penetrates into the ear, gradually softens the wax, and imperceptibly but thoroughly cleanses the meatus. These means, whether employed by educated physicians or by charlatans, effect a great number of brilliant cures, which make an impression on the public, and even on many professional men, in exact proportion as the functional disturbances of these superficial affections of the meatus simulate those which accompany other much graver and more incurable diseases of the ear. We can in this way only too readily explain how the above-mentioned remedies, acting simply and gradually by the removal of the ceruminous masses, have obtained the unmerited name of specifics. The prognosis of this disease is extremely favorable. It is always easy to remove the abnormal ceruminous secretion, and thus to ensure, in by far the majority of cases, the immediate and complete removal of the accompanying hardness of hearing and noise in the ears—or at least to effect material improvement in these symptoms.

The treatment of inflammation of the cuticle of the meatus is completed on removal of the ceruminous secretion. In the greater number of cases, no preparatory treatment is necessary; occasionally, however, it may be requisite to soften very hard collections of cerumen (which cannot be perforated by an ear-pick), with the instillation of a little warm olive oil. When this has been done, the best injection is that of pure lukewarm water, by means of a caoutchouc syringe, the size of the fist. The stream of water should be directed against the plug of cerumen by pulling the auricle upwards and backwards; usually it becomes loose after the syringe has been discharged a few times, and in a few minutes is completely removed. We must convince ourselves, in each case, that this has really taken place, by careful examination with the speculum. Immediately after

its removal the noise in the ears always vanishes completely, the accompanying deafness being in great measure relieved, if it be due to the ceruminous masses ; if, on the other hand, it results from disease of the tympanic cavity, it is only improved ; and this in proportion to the share which the ceruminous collection may have had in its production. After the ears have been injected, they should be filled with warm olive oil, and plugged for a few hours with soft charpie ; as a rule, we then find that all redness of the membrana tympani, and of the integuments of the meatus, have passed off. The former is again brilliant and transparent, or becomes so at latest on the following day, and the treatment may then be considered to be completed.

Removal of Foreign Bodies from the Meatus.

The removal of all foreign bodies (a term which has often and justly been applied to ceruminous collections) is to be effected by the same means. Foreign bodies may be of very various nature ; they include glass and other kinds of beads, beans, peas, bulbous roots, needles, cut stones, &c. ; these are commonly found more or less tightly wedged into the meatus, close to the membrana tympani, and always so placed that every time it is touched it presses in an extremely painful manner either upon it or upon the integuments of the meatus, so that neither the voluntary control of the patient himself, nor the application of external force, is sufficient to prevent violent movements of the head from being made ; and it is, therefore, almost impossible to employ instruments for the removal of foreign bodies ; every attempt to do so in children being fruitless, even when chloroform is administered. Laceration of the membrana tympani, serious injury to the periosteum of the tympanic cavity, with consecutive and fatal inflammation of the dura mater, are consequences which, even in the hands of eminent surgeons, I have seen result from attempts to remove foreign bodies from the meatus. It would, therefore, be quite useless to enumerate the various instruments which have, even up to a very recent period, been suggested for this purpose. It is only in cases where the foreign body lies in the outer part of the meatus, and does not quite fill it, or where it is of a fibrous nature, that we can advantageously employ without any risk, a pair of closely approximating angular forceps, with broad ends, which should have little teeth upon their inner surface (see fig. 4). In all other cases, we need only employ in-

jections of lukewarm water, by means of a vulcanized India-rubber syringe, the size of the closed hand, with which we are enabled to direct the stream of water upon the foreign body, if the auricle be strongly pulled upwards and backwards. By this means, the water penetrates behind it with the continuance of the injection, raises it, and even where most firmly impacted, in a perfectly gentle and quiet manner washes it unfailingly out of the ear. Where the meatus is inflamed and swollen in front of the foreign body, so that there is no space for it to escape, which indeed only results from violent instrumental interference, we must allay the inflammation by leeching and the instillation of oil, and we may then have recourse to injections with every prospect of success. But since it has actually happened that persons have believed that they have had a foreign body in the ear when none was present; we ought always to convince ourselves of the fact by making a careful examination with the speculum and direct sunlight. Living insects and worms should be killed by pouring in warm oil before using the injection. If, from the improper use of instruments, the meatus or the membrana tympani, or as sometimes happens the parts even within the tympanic cavity, be injured and inflamed, antiphlogistic treatment should be adopted as soon as the foreign body has been removed, with the application of leeches and the instillation of oil, or a weak solution of acetate of lead, &c.

FIG. 4.



Inflammation of the Corium of the Meatus.

In one, or more rarely in both ears, there appears a pale-red, granular, vesicular, uneven or smooth swelling, which spreads itself over the whole meatus, and greatly contracts its diameter. This is accompanied with considerable itching, burning, and dragging pain, that gradually becomes very severe, especially towards night. The secretion of cerumen rapidly diminishes, and is replaced by a serous or sero-mucous secretion, that at a later period becomes soft, caseous, purulent, foul, or even foetid and corrosive, causing

ulceration of the auricle, and the neighbouring part of the cheek. When this occurs, these parts present numerous pustules, bleeding cracks and fissures, with great heat and redness. If the ear be cleansed by injection and the meatus be not too much narrowed, the membrana tympani may be seen dull, opaque, white like paper, or more or less reddened. In rare cases a croupous and apparently firm, dark-coloured membranous exudation forms, with slight swelling of the dermis, which completely closes up the meatus, and is very firmly attached, so that its removal produces acute pain. After being detached, it frequently reappears quickly, and this will occur several times consecutively. In other rare cases flat or pedunculated fleshy tumours spring from the inflamed dermis of the inner third of the meatus. Constitutional febrile disturbance is seldom present, and generally soon passes off; but there is always well-marked difficulty of hearing, the grade of which is in exact proportion to the narrowing and obstruction of the meatus from the swelling of the dermis, and from the abnormal secretion. Noise in the ears is only experienced when the membrana tympani is inflamed. To these tolerably numerous cases of primary inflammation of the dermis must be added, the far less frequent instances of secondary inflammation of the integumentary layer, which result from caries of the meatus and of the tympanic cavity, or from destruction of the membrana tympani with disorganization of the investing membrane of the tympanum. In such instances the meatus tumeфes, becomes indurated like cartilage, smooth, and dark-red; the opening closes up till it will only admit the head of a pin; there is a thin, acrid discharge, and on introducing a probe, bare, rough, and carious bone may be felt in the deeper part.

If the carious bone be thrown off, as it usually is, by imperceptible exfoliation, the inflamed surfaces of the dermis readily coalesce, and the meatus is permanently occluded. This secondary inflammation of the dermis affects usually the inner third only of the meatus. It very rarely attacks, in addition, the dermis of the auricle, producing the already described chronic form of inflammation (p. 37) with the formation of obstinate scabs (milk scabs, cancer, elephantiasis, leprosy, &c.).

The course of both of these forms of inflammation of the dermis is chronic, and they are not accompanied by febrile symptoms, unless at a later period hectic fever is established, and then it does not proceed from the aural disease alone.

The primary dermal inflammation never attacks the deeper layers of the skin, and even the consecutive inflammation of the membrana tympani takes on no destructive character. The primary dermal inflammation generally proceeds from catarrh, but occasionally from some chemical or mechanical irritation, as from essential oils, tinctures, eau de Cologne, or brandy and salt being dropped into the ear, or from rough attempts to remove foreign bodies from the ear by means of surgical instruments; an unhealthy constitution has a marked tendency to produce a chronic form of the affection, or to develop secondary inflammation of the membrana tympani.

The prognosis varies considerably, according to the nature of the causes producing the disease. The catarrhal subacute form is in general readily curable in persons of sound constitution, as is also that form of inflammation which is occasioned by the application of local, chemical, and mechanical irritants. When the scrofulous diathesis is unmistakeably present, the cure of the aural disease is wholly dependent upon the removal or essential improvement of that constitutional disorder. We may readily conceive that incurable cases are sometimes met with, as in those in whom the dermal inflammation results from caries of the meatus and tympanic cavity, with coalescence of meatus, that is of the surfaces of the dermis of the meatus.

The treatment of subacute inflammation of the dermis when the weather is cold and damp, consists in rest at home, simple unstimulating food, and regular daily evacuations. The ear should be injected with warm water once or twice a day, with the caoutchouc syringe, after which a few drops of a weak solution of sulphate of zinc (gr. i—v ad $\frac{3}{4}$ aquæ) should be dropped into it, allowed to remain for ten minutes, then removed, and the meatus stopped with fine charpie. Under this treatment the discharge becomes less acrid, the clefts and cracks of the skin in the immediate vicinity heal up, the itching and burning of the ear cease, the hypertrophy of the dermis gradually diminishes, and becoming dry entirely disappears. The meatus reassumes its natural colour and size. The membrana tympani becomes white, and by degrees transparent and shining, and the power of hearing is regained. Lastly, the suppressed secretion of cerumen returns. Counter-irritation by blisters, &c., behind the ears is perfectly useless, and does not in any way promote the cure.

When chemical and mechanical irritants have acted on the meatus,

daily repeated injections must be used for their removal from the suppurating ear, with subsequent instillation of lukewarm oil, in order to check the rapid course of the inflammation.

Croupous exudation must be softened by the application of warm poultices of bread or linseed meal; the accompanying pain may then be moderated, and the softened plug removed by strong injections of lukewarm water.

The shining, red, but slightly swollen, yet very sensitive dermis, must be painted every second or third day with equal parts of tincture of iodine and tincture of laudanum, throughout the whole length of the meatus. Acute pain is experienced, but the reproduction of the croupous exudation is prevented, and the inflammation of the dermis completely subdued.

If the secretion from the meatus be very corrosive and the itching very violent, so as even to prevent sleep, very great advantage is derived from daily injecting the ears with lukewarm water and then dropping in a solution of corrosive sublimate (gr. ss—j in aquæ ʒj) once or twice a day. If any constitutional affection, such as scrofula, be present, and especially in protracted cases, full meat diet should be ordered, with the well-known anti-strumous remedies, especially the Kreuznach, Eliza, Adelaide, and other baths. In suitable constitutions, Fowler's arsenical solution should be prescribed.

Where the dermal inflammation is secondary, and is the result of some deep-seated disease of the bones, the cure of this must first be accomplished by injecting the meatus thoroughly every day, in order to remove and prevent any accumulation and decomposition of the abnormal secretion. All attempts to widen the contracted condition of the meatus which accompanies this disease, by means of catgut, sponge-tents, metallic tubes, nitrate of silver, or any other caustic, are perfectly useless, and these means are equally unsuccessful if employed to maintain the meatus pervious after the swelling of the dermis has been incised with a bistoury or penetrated with a trocar.

Sometimes polypi form upon the inflamed dermis, and these may be either flat or pedunculated; the flat ones should be destroyed by sprinkling them with powdered sulphate of zinc or nitrate of silver; but the pedunculated variety may either be snipped off or ligatured, and the root destroyed by the means just mentioned. The instruments to be employed will be described hereafter, in discussing the treatment of the far more frequent polypi of the inflamed membrane tympani, and drawings of them will also be given.

Inflammation of the Connective Tissue of the Meatus.

Near the entrance of the meatus, seldom more deeply seated, and never beyond the outer half, there appear one or more round tumours, about the size of a pea, which are painful on pressure, but present little or no redness. These are always developed with symptoms that are somewhat similar, though often still more violent than those which accompany the last-described affection. There are lancinating, tearing, or boring pains in one or both ears, which destroy sleep, and extending to the vertex, occiput, and cheeks, into the throat, and even into the upper arm, make the opening and shutting of the mouth difficult, or even impossible. The meatus closes up to an almost imperceptible slit, from which on the second or third day, or even later, there proceeds a very sparing, thin, and colourless secretion. The tumour itself is quite dry, elastic, and smooth, and upon introducing a blunt probe we can perceive that the meatus behind the swelling is wide, and free from tumefaction. With the occurrence of these symptoms the secretion of cerumen immediately and completely ceases, and does not reappear till the inflammation has subsided. When the pain is very great, and the patient irritable, a febrile condition is often established, which, however, is often absent, though all patients suffer from debility, loss of appetite, &c.

It is impossible to ascertain whether the membrana tympani be implicated or not, except by observing after the cure of the obstructing tumefaction has been effected, whether it is opaque, white, or red in colour, and forms a secreting surface. In a few instances the cellular inflammation extends from the meatus to the connective tissue of the temporal muscle and of the processus mastoideus, with severe pain, great tension, and dark, livid, redness of these parts.

Inflammation of the connective tissue is constantly associated with very great difficulty of hearing, and the deafness is in proportion to the closure of the meatus. Noise in the ears is more rarely observed, and only in those cases in which it can subsequently be shown that the membrana tympani was inflamed.

When the disease is neglected, it drags on slowly for weeks, the pain continuing with unbroken violence, whilst under proper treatment, and frequently even in a few days, the tumour can be so far matured as to form pus; fluctuation may be perceived, and it opens spontaneously; on its opening, and with the evacuation of its contents, which always consist of a mixture of blood and pus, the patient

feels immediate and complete relief from all pain ; if, however, there be several abscesses in the meatus, of which only the most external one has burst, the relief will of course only be partial. In order to complete the cure, it then only remains to secure the maturation, and the evacuation of the contents of the others in succession. At the summit of the small tumours a scarcely perceptible opening may often be seen, from which the last remains of pus may be squeezed out by pressure. It is far more difficult to produce softening, or even obscure fluctuation in the inflammatory swelling upon the mastoid process and temporal muscle, and we may wait in vain for its spontaneous opening.

When these small abscesses have discharged, their cavities quickly heal up, and require no further attention ; whilst the cure of the affection above and behind the ear demands but little interference on the part of the surgeon. The inflammation of the cellular tissue over the temporal muscle and mastoid process only extends to the periosteum in cachectic and very debilitated persons. It produces widely spread, but seldom deeply penetrating caries ; and this terminates either in imperceptible exfoliation, or in the separation of larger fragments of bone.

The dermis of the meatus is never implicated in inflammation of the connective tissue ; in fact, the inflammatory process in the latter is so distinct in its course and characters, that we can scarcely comprehend how Bonnafont can make the assertion that it is impossible to distinguish one from the other.

Inflammation of the connective tissue occurs most frequently in the middle period of life, and in those who have previously enjoyed good health. I have never observed it below the age of twelve or above that of sixty. The most frequent cause of the disease appears to be exposure to cold, as may be proved, or presumed, for so many other affections, though this does not in any way aid us either in their prevention or cure. The prognosis is very favorable. Even in unhealthy constitutions, the inflammation is limited to the connective tissue ; suppuration soon occurs, and the little abscess bursts quickly and without danger. Under very unfavorable circumstances, slight purulent infiltration does certainly take place, followed by inflammation of the periosteum and caries of the bone.

As regards the treatment, in spite of the sharp local inflammatory symptoms, we have only seldom to deal with general febrile conditions, or to apply the usual well-known measures for their relief.

In by far the greater number of cases it is sufficient to leave the patient to his own natural aversion to food, to keep him in the house, and to carry out fully the local treatment. The affected ear, as well as the inflammatory swelling, above or behind the auricle, must be covered with thick hot poultices of bread or linseed meal, inclosed in soft linen, and renewed every half hour through the day and night. The poultice should be so moist as to thoroughly wet the linen, without dropping from it. It should never feel cold to the ear; on the contrary, the hotter it is applied and kept without burning the skin, by so much the more rapid is the progress of the disease, and by so much the greater is the relief from pain. If the fatigue and weariness be extreme at night, the poultice may be removed, and its place supplied by a small quantity of charpie dipped in warm olive oil, which can be retained in the ear by a bandage round the head. As soon as the patient awakes, the use of the poultice should be recommenced, and continued until the pain in the ear (usually suddenly) completely disappears, which indicates that the abscess has burst, and its contents have been discharged. If the pain still continues, we may feel assured that there are several abscesses, one only of which has burst, and we must endeavour, and shall certainly succeed in procuring the discharge of the others by the continuous application of poultices.

Whether there will be one or more abscesses cannot be determined, even after eight days have elapsed, since the number is entirely dependent upon the constitutional peculiarities of the patient upon the duration of the disease, and his previous care or neglect of it.

Suppuration in the connective tissue of the meatus never requires opening by the surgeon. The pus is always evacuated spontaneously into the meatus, and so advantageously that no further after treatment is requisite, since the feeling of pain in mastication, in yawning, and on firm pressure made before and behind the ear, soon cease. The meatus quickly returns to its natural dimensions, and the normal power of hearing, which existed previously to the attack of inflammation, is again restored. When this occurs, the meatus should in all cases be thoroughly injected with warm water, in order to clear out the purulent secretion, which has by this time usually become only sparing in quantity.

When the inflammation of the connective tissue has extended itself over the temporal muscle and the mastoid process, the continuous application of emollient bread poultices is all that is necessary to lead

to fluctuation in the frequently very tense swelling. Immediately upon the occurrence of this, the abscess should be opened with a lancet. The treatment here also occupies but little time if the patient be otherwise healthy and strong. The cavity of the abscess closes up with surprising rapidity, even when it is of considerable size, and has contained much pus. If, however, the patient be very much debilitated, or suffer from some unhealthiness of constitution, or be an aged and cachectic person, he requires not only an improvement in the social conditions under which he is living (moist, cold habitations, bad and insufficient food), but the bread poultices must be mingled with aromatics (chamomile flowers), grated onions, and soft soap, in order to awaken sufficient activity in the inflammatory swelling for the formation of pus. The abscess must then be opened as quickly as possible by a free incision. By these means infiltration of pus and caries will probably be avoided, but if not, the subsequent treatment must be conducted according to the ordinary rules of surgery.

Inflammation of the Periosteum of the Meatus.

The process of development of this form of disease is generally almost completely withdrawn from medical observation, partly on account of the very small amount of pain, or complete absence of pain, which accompanies it, partly on account of its being frequently associated with other far more violent and fatal diseases—as smallpox, scarlatina, measles, and typhus—and partly, also, on account of the usually very tender age of the patients. It is in general discovered by pure accident. A discharge of pus takes place from one ear, and, on examination, a narrow fistulous opening is perceived deeply situated in the meatus, and close to the tympanum. Upon introducing a blunt probe it strikes against a surface of exposed bone, contact with which produces only occasionally a little pain. At other times, we find fistulous openings on the mastoid process which communicate with the meatus, and the probe, when introduced, leads to carious portions of the bone forming the meatus, and caries of the mastoid process. In these cases of simple caries of the meatus the membrana tympani still remains entire, and only appears white and thickened; but very frequently, and especially in complicated cases, it is perforated, and, in many cases, wholly destroyed, the exposed mucous membrane of the tympanic cavity being dark-red, swollen, and sometimes very sensitive; in which cases, periostitis and caries are also usually present.

If the caries of the meatus be only of moderate extent, the inflammation extends to the dermis in the immediate neighbourhood of the membrana tympani, which reddens, swells up, and narrows the meatus in its inner third to the size of a pin's head ; from this the commonly thin dark-coloured secretion of the diseased periosteum oozes.

Hardness of hearing is present in all these cases, and often amounts to almost complete deafness. If the periostitis of the meatus extends to the mastoid process, there appears a gradually increasing, deep-seated, and obscurely fluctuating tumour, accompanied by a dull, heavy pain, and great tension of the parts. Upon the spontaneous bursting of this tumour, or after it has been opened, the probe either strikes against an extensive surface of carious bone, or else penetrates deeply into the substance of the mastoid process, and may be passed from it into the external meatus. Injections thrown into either passage return by the other one, indicating that they communicate in the substance of the bone. The discharge, especially in these complicated cases, is dark coloured, irritating, foetid, sharp, excoriating, containing black particles of bone, or even considerable pieces of the bony meatus and of the mastoid process, after the exfoliation of which the healing of the fistula occurs, a deep scar indicating its former position. Complete deafness is a constant result of this disease. When portions of necrosed bone are discharged after long suppuration, the chronically inflamed dermis usually hypertrophies and occludes the meatus.

Periostitis of the meatus is apparently a rare disease ; at least I draw this conclusion from the cases which have come under my observation. It either results from a well-marked dyscrasia or unhealthy constitution, or from the operation of injurious influences, which, as in the virus of scarlet fever, smallpox, or measles, are in certain epidemics especially liable to affect dangerously the organ of hearing. It is almost always met with in childhood, and probably because at that time both the constitutional disorder and the tendency to the local disease, are more rife than at any other period of life.

The prognosis is very unfavorable, because the disease in question is not usually recognised until it has attained its full development, and also because the tedious constitutional affection requires to be combated by abundant nourishment continued for a long period ; and even if our skill enable us to overcome the carious disease, still the functions of the ear remain irreparably damaged. The treatment must be chiefly directed to the improvement of the general health by

residence in warm, pure air, cleanliness, simple but good food, specific alterative medicines, as natural and artificial baths, and the use of Molken, Kreuznach, Eliza, Adelaide, and other similar springs. Locally, it is indispensable to maintain perfect cleanliness by the daily injection of warm water, that the accumulation of foetid pus in the fistulous canals may be avoided.

If we are so fortunate as to recognise the periostitis at an early period, as it is extending over the mastoid process, we should endeavour to check its progress by leeches and by rubbing in blue ointment, and if obscure fluctuation be perceived, early suppuration should be promoted by the application of emollient poultices of bread, in order that we may then evacuate the contents as soon as possible, and thus prevent further destruction of the bones. When loose pieces of bone can be felt in the fistulous canals, we must endeavour to remove them by widening the fistulae, the cure of which will thus be materially hastened.

If the meatus closes up, we are unable either to open it, or, if that be accomplished, to maintain it pervious, and are, therefore, incapable of improving the deafness by these means. This condition is simply incurable.

DISEASES OF THE MEMBRANA TYMPANI.

Notwithstanding the position of the membrana tympani, protected alike by the small diameter and the windings of the meatus, notwithstanding its comparative dryness and its inability to perform any act of secretion, it is yet so frequently affected that in almost every fifth case of aural disease it becomes more or less implicated (*Vide* Table, p. 17. 218 : 1000 = $\frac{1}{5}$). It is even still more frequently affected when it is included among the general integuments of the meatus (218 : 206).

The diseases of the membrana tympani always originate in an inflammatory process, which, in the majority of instances, is primarily developed in the membrane itself, and does not affect the neighbouring structures, especially if its continuity be preserved and no perforation have taken place. Inflammation of the membrana tympani is always followed by a kind of disorganization, producing thickening and perforation of this originally very delicate structure. These changes immediately destroy its vibratory power, and necessarily, therefore, seriously impair the faculty of hearing. In fact, difficulty of hearing,

though of course varying much in degree, never fails to be present in disease of the membrana tympani, and it is much to be regretted that our information on this subject is often restricted to the vague and loose statements of the patient.

The prognosis of the diseases of the membrana tympani is very unfavorable, so far as regards the recovery of its normal state, because, on the one hand, there is a great deficiency of vessels of any kind, and especially of the absorbents; and on the other, because of the rapid and very remarkable disorganization to which it is liable. The injurious effect which these circumstances have upon the recovery of the hearing, especially in those cases where the disease has escaped notice, is often very strikingly exhibited.

The treatment, considered from a general point of view, consists chiefly in the application of local means, though doubtless there are various cases in which constitutional remedies should be by no means entirely neglected. Every disease of the membrana tympani, in order that it may be rightly understood and rightly treated, requires the most careful examination by means of my split speculum, with good sunlight illumination, the place of which can neither be supplied by reflected light from "white clouds or walls" (v. Troeltsch), nor by the light of oil, gas, or photogen lamps, even when increased by a stream of oxygen (Voltolini), nor by biconvex lenses and reflectors. This must always be borne in mind, wherever in the following treatment of diseases of the membrana tympani, I speak of the symptoms, for I have always made my examinations by this objective mode of inquiry; and further, I will here remark, once for all, that for the purpose of injection I only employ, as above mentioned, a caoutchouc syringe the size of the closed fist.

Acute Inflammation of the Membrana Tympani.

This affection usually commences without any premonitory symptoms; but deep-seated, stabbing, and tearing pains suddenly set in, especially at night, in one or the other ear, very often extending to the vertex, to the throat, jaw, and neck, on the same side. It is rare for both ears to be attacked at the same time, or for one to be seized after the other. The pain, often within a few hours, becomes extraordinarily acute, completely preventing sleep, and making the patient very agitated and restless. Noise in the ears is generally present (in twenty-six cases out of thirty-five), hardness of hearing

always, and at an early period, though it can often only be ascertained by tightly closing the sound ear. Febrile symptoms are not often present, and then only in a mild form. We must, however, make an exception to this statement in those cases of acute inflammation which, though often unnoticed, so frequently occur in the course of violent exanthematous and typhus fevers. The pain almost always remits towards morning, with the discharge of a colourless serous fluid, and again returns in the evening with increased severity. How often these alternate remissions and exacerbations will take place before permanent improvement occurs, depends upon the nature of the case, the constitution of the patient, and the treatment that may have been adopted. The change of the serous into a mucous creamy discharge, containing shining white epithelial scales, is usually accompanied by complete remission or very material relief of the pain.

If we inject the affected ear with warm water, and then examine the meatus, it will be found healthy, with only a deficiency of cerumen. At the bottom the membrana tympani appears dull, opaque, partially or generally reddened, and of all shades of colour, from pale rose to purple; it is flattened, its natural concavity being lost, and it may even be convex forward, in either case from the effusion of plastic lymph between its layers. Its surface may be either smooth, or uneven and granular, like a strawberry, the manubrium and processus brevis of the malleus being no longer visible. We may often discern during the first few days a perforation in the larger posterior part of the membrane, where it forms a depression, in which a drop of fluid rests. This may be seen to pulsate isochronously with a beating felt by the patient in the ear, which often becomes very annoying; the membrana tympani is extraordinarily sensitive, the slightest touch, even the gentlest stream of water, or the softest paint-brush, producing stabbing pain, so that when we inject the ear we are compelled, in consequence of the absence of cerumen, to direct the stream, not against the membrane itself, but against the posterior wall of the meatus; the water then flows gradually back and sufficiently cleanses it. Inflammation of the membrana tympani is sometimes a consequence of a severe catarrh of the tympanic cavity. In such cases we find the membrane within the first forty-eight hours reddened, as above mentioned, dry, shining, and concave. The secretion of cerumen in this case is unaffected, until the inflammation extends to the external layer, and thus induces the usual

group of symptoms that indicate inflammation of the membrana tympani.

In these rare cases the patients observe the first lancinating pains in the ear on strongly blowing the nose when the mouth is closed, by which means considerable pressure is exerted by the air upon the inner side of the membrana tympani. When left to itself, the discharge from the membrane, which was at first colourless, changes into a thick, clotted, greenish-yellow, puriform substance, in which the white shining epithelial scales are no longer to be discerned. With this alteration in the character of the discharge, the pain ceases, and the acute passes gradually into the chronic form of the disease. Amongst 7000 cases of diseases of the ear that have fallen under my observation, acute inflammation of the membrana tympani has occurred 177 times; 164 times in one ear and 13 times in both ears. These have been accompanied 151 times with violent, and 16 times with only slight and transient pain. In 28 cases febrile symptoms were present, in 139 cases there were none. Noise in the ears was complained of in 123 cases, but was absent in 53. Perforation of the membrana tympani occurred in 137 cases, whilst in 40 it was entire.

Hardness of hearing is in all cases distinctly marked, and sometimes amounts to almost complete deafness. Acute inflammation of the membrana tympani occurs generally in young and healthy persons. In unhealthy constitutions it passes quickly into the chronic stage. Its most frequent causes are keen, chilly draughts of air, the entrance of cold water into the ears in washing or in the shower bath, or whilst bathing in the sea or river, the dropping in of sharp spirituous fluids (to remove toothache !), injury to the membrane from surgical instruments in the attempt to remove a foreign body, blows on the ear, and violent shocks produced by salvoes of artillery.

Whether in the exanthemata it is produced by the extension of the exanthematous inflammation or of the inflammation of the throat to the membrana tympani, has not yet been precisely ascertained; and its mode of origin in typhus fever is equally uncertain. The prognosis is in general very favorable if the disease run its course without any complication. It is completely curable with all its accompaniments of perforation, noise in the ears, hardness of hearing, thickening, and the like, providing the treatment is commenced early, and is appropriate, and that we are able to subdue the febrile condition which is associated with it. The impossibility of fulfilling this

last condition in the exanthemata, in typhus and in phthisical fever, is the true reason why, in these affections, acute inflammation of the membrana tympani takes on so dangerous and destructive a character.

The treatment consists in paying the closest attention to the general febrile symptoms, the exposition of which does not belong to this work ; locally, it must be at once sustentative and antiphlogistic. In unfavorable weather, the patient should not leave the room, nor even the bed, he should take nothing heating, and daily free evacuation of the bowels should not be neglected. Leeches should be applied around the ear, in number proportioned to the violence of the pain, and the subsequent bleeding encouraged until the pain has entirely ceased. A warm bath in recent cases, and especially amongst childreu, operates very favorably in alleviating the pain. Counter-irritation of the skin, blisters &c., especially when applied at a distance from the ear upon the nape of the neck, or lower down still, and not larger than a dollar, remaining open perhaps one day are perfectly valueless.

The meatus of the affected ear must be daily, or according to the quantity of the secretion two or three times a day, injected very gently with lukewarm water, in order that the cerumen may not accumulate. The head should then be inclined to one side, and the ear thoroughly dried with soft linen. Warm olive oil must now be poured in, and the meatus stopped with soft charpie, in order to keep the membrana tympani in a warm oil bath. As long as the pain continues, the application of this warm oil should be repeated three times a day ; and its effect will be promoted, should the pain be very violent, by using warm bread or linseed meal poultices, mixed with hyoscyamus or the water hemlock.

Under this treatment the pain, as a rule, vanishes in a few days, and the discharge of pus from the membrane gradually ceases as the inflammatory symptoms disappear. The membrana tympani becomes again concave, transparent, and even the perforation itself leaves scarcely any trace behind ; noise in the ears and dulness of hearing pass away by degrees, and at length the returning secretion of cerumen indicates the termination of the whole inflammatory process.

If, contrary to expectation, after the removal of all the acute symptoms, considerable discharge of pus and reddening of the membrana tympani continue, we have then to deal with the chronic

stage of the malady, the treatment of which will be fully detailed in the following pages.

If we are so fortunate as to recognise, amongst the other serious symptoms, the commencement of acute inflammation of the membrana tympani in the progress of exanthematous and typhus fevers, we must recommend, in addition to the above-described local means, especial circumspection in the avoidance of cold poultices and applications.

When acute inflammation of the tympanum accompanies pneumonic or laryngeal disease, we must look for the means of cure, not, indeed in local remedies, which will prove of no avail, but in a removal of the patient to some warm climate, as to Egypt.

Chronic Inflammation of the Membrana Tympani.

This disease commences with slight pain in one, or more frequently in both ears; but which, on account of its slight character, often remains almost unheeded, or is soon altogether forgotten.

Presently, a greyish, yellowish, greenish, or dark-brown secretion, sometimes streaked with blood, begins to flow in greater or less abundance; it is irritative, sharp, corrosive, fœtid, sometimes thin, sometimes tenacious or clotted; it soon dries up in the meatus and on the membrana tympani, with dark-brown strongly adherent crusts. These are so well characterised by their fœtid odour, by their green colour, by the pus which adheres to their inner surface, and when dissolved in warm water by the greenish tint which they give to it, that they can scarcely be mistaken for hardened concretions of cerumen. When the abnormal secretion has been removed by the injection of warm water into the ear, we find (with the exception of certain cases where the secretion has been very acrid, and where, consequently, the dermis is inflamed and swollen), the meatus healthy and natural in colour, but in its deeper part there is sometimes visible a dirty-white, speckled, or dark-red, smooth or uneven, lustreless, opaque surface, which from its position ($1\frac{1}{3}$ inches from the tragus, capable of being reached with the probe in adults, and firm, hard, and painless on being touched), we must consider to be the degenerated membrana tympani, although it is only rarely that we can recognise in shadowy outline, the manubrium and processus brevis of the malleus. This simple form of chronic inflammation of the membrana tympani (No. 10, *a*, in the Table), which I have observed 64 times in 183 cases of chronic inflammation, and in 1000 cases of aural disease, has been associated 13 times with noise in the ears, whilst in 51 cases

this symptom was not present; the proportion between the two being therefore as 1 : 4, a proportion which is directly reversed in acute inflammation of the membrana tympani, involving the chorda tympani, when noise in the ears existed in the ratio of 26 : 9 = 1 : 4. Perforations of the chronically inflamed membrana tympani, with thickening and induration from interstitial deposit, are more frequently met with (87 times in 183 cases, Table No. 10, b). They occur most frequently in the posterior and larger half of the membrane, and are occasionally, though very rarely, met with in the form of ulcers above the processus brevis mallei. The perforations vary in size from that of a pin's head to the complete destruction of the membrane, in the latter case the three ossicula are inevitably lost, unless perchance, owing to the swelling of the investing membrane of the tympanum, the stapes is retained. I have only once seen (where the membrana tympani was wholly destroyed), the chain of bones still fixed in natural position in the exposed cavity of the tympanum. When the loss of substance extends to that portion of the membrane which covers the malleus all that part of the latter which is thus exposed is destroyed, and comes away by ulceration.

Sometimes the membrana tympani is reduced to a narrow, circular, or semilunar strip, and we then generally find the neck of the malleus in the form of a short, pointed process, directed upwards and forwards, and extremely sensitive to the touch. Perforations of the membrana tympani are usually very regularly circular, and we never see several present together in the same membrane. In rare instances the membrana tympani is of a grey colour, and but little thickened, and then the edges of the perforation are well and sharply defined; but in the majority of cases the opposite holds good.

The perforations of course expose a similarly-sized portion of the cavity of the tympanum, which enables us to see its mucous membrane, which appears very red, moist, and swollen, sometimes indeed to such an extent, that it presses against the membrana tympani, and fills up the perforation. In these cases, it is by the sharp border of the membrane alone that the surgeon is enabled to distinguish between the remaining portion of it, and the swollen and closely approximated mucous membrane of the exposed tympanic cavity. A pale, or dark-red, moist, spongy, or fibro-cartilaginous outgrowth, which is sometimes flat, sometimes pedunculated, the projecting portion protruding from the meatus, is sometimes developed from the altered and now secreting surface of the chronically inflamed

membrana tympani, which may be either perforate or entire. Some of these bleed easily (*mucons polypi*), while others pour forth an abundant purulent secretion. This occurs according to the Table 29 and 3 times amongst 183 of these cases (see Tabular statement, No. 10, *c* and *d*). It is extremely rare to find the root of the polypus implanted on the *mucons* membrane of the exposed tympanic cavity; when this does occur, it is indicated by the exquisite sensibility it displays on being touched, and especially on any surgical interference. The contradiction which many writers give to the statement that these polypi spring from the membrana tympani, may be best shown to be erroneous by treating their roots with nitrate of silver, which always indicates that they end at, or spring from the membrane. Polypous growths from the membrana tympani are still less frequently accompanied by noise in the ears than perforations ($5 : 24 = 1 : 5 = 0 : 3$), in which last, however, it must be stated that noise in the ears is always absent providing the membrana tympani be wholly destroyed, and with it the chord tympani, the presumed seat of the noise.

In all these various forms of chronic inflammation of the membrana tympani, one thing is never wanting—diminution in the power of hearing, which may be either mere dulness or hardness of hearing, or may amount to complete deafness. The higher grades of deafness are generally met with in association with the thickened and imperforate, and in the completely destroyed, or indurated membrana tympani; in these latter cases remarkable instances of very complete deafness occur. In aural polypi, deafness is always well marked, whether they are pedunculated or sessile; but it is generally greater in degree, in proportion to the more or less complete occlusion of the meatus, and the more or less complete disorganization of the tissues of the chronically inflamed membrane.

Occasionally the inflammation of the imperforate membrana tympani extends to the connective tissue or periosteum of the mastoid process, with more or less violent, tearing pain, tension, swelling, and livid redness of the integuments, and marked tendency to the formation of pus. Very rarely, and it is fortunate indeed that it is so rare, the inflammation extends from the perforated membrana tympani to the periosteum of the tympanic cavity, the dura mater, and to the substance of the cerebrum, and especially to that of the cerebellum. This sometimes comes on slowly, sometimes rapidly, but is always very dangerous; it is indicated by deep-seated,

either persistent or intermittent pain, reaching to the vertex or to the occiput, which is especially excited by contact with the polypi, when present, or by touching the exposed tympanic cavity. It is indicated also by sensations of pressure, weight, and numbness in the head, and by incapability of maintaining the head erect, as well as by great sensitiveness to shocks, as in walking on stone pavement, striking the head with the knuckles, and the like; by typical or atypical rigors repeated several times a day, with or without subsequent hot fits, by paralysis of the facial muscles, and even of the arm on the same side, and especially by abundant irritative foetid discharge from the ear which has already long been perfectly deaf. Death generally ensues accompanied by deceptive symptoms of typhus fever, with cerebral complication. Thus the chronological succession of the entire series of symptoms indicates that the primary cause of the caries of the temporal bone, of the discoloration, detachment and suppuration of the dura mater attached to it, of the sinuses, and of the cerebrum or cerebellum, as shown by dissection, lies in inflammation and perforation of the membrana tympani. There has never yet been even a single accurate observation made which could furnish any grounds for admitting "*otorrhœa cerebralis primaria*," and we must therefore regard such an affection as purely theoretical, and wholly unsupported by experience.

When the membrana tympani is perforated, water, which has been injected by the ears, will flow out by the nose and mouth, either drop by drop, or in a full stream, the latter occurring if the stream of the injection exactly hits the opening, and there happens to be neither swelling of the mucous membrane of the tympanic cavity, nor of the Eustachian tube, which may form obstacles to the flow of the water. When such swelling, however, does exist, it will be found to be impossible either to press or blow air (tobacco smoke) with an audible noise through the perforation, although it may be perfectly visible to the eye.

In making an examination of the middle ear of those who are suffering from chronic inflammation of the membrana tympani, we find that the air will only pass by driving a strong blast of air through catheter No. 3 (see below). Moreover, interstitial exudation is constantly present, and is but rarely accompanied by free exudation on the surface of the membrane. The expulsion of the latter by catheterism rarely proves of much service to the patient in the recovery of his hearing; in fact, as a rule, the hearing is more or less impaired by the operation, though only transiently.

Chronic inflammation of the membrana tympani is so frequent that it occurs in the proportion of almost one in five of all aural diseases (183 : 1000).

Supposing now that we include also the above-mentioned thirty-five cases of acute inflammation of the membrane, the proportion of cases in which there is an abnormal muco-purulent secretion will be 218 in 1000, whilst, on the other hand, this symptom is observed only in twenty-two cases of inflammation of the dermis, and in three cases of periostitis of the meatus (see Table, Nos. 6 and 8). We thus obtain the knowledge of an important fact in the treatment of aural diseases; that in cases where there is an abnormal muco-purulent discharge from the ear, we may predict, without making any special examination, that not less than nine cases in ten ($218 + 25 = 243$) are sure to be inflammation of the membrana tympani, and only one inflammation of the dermis of the meatus.

Children, and those of an unhealthy constitution, have the strongest predisposition to chronic inflammation of the membrana tympani, and in them it is occasioned by exposure to cold, and especially by the exanthemata, scarlet fever, measles, and smallpox. We find in reference to these causes that various authors describe scarlatinous, morbillous, variolous, catarrhal, rheumatic, arthritic, and even syphilitic inflammation of the membrana tympani, but the proofs of the specific and characteristic symptoms of each of these have not yet been given, so that there is little or no practical value in such minute distinctions. The prognosis of chronic inflammation of the membrana tympani is upon the whole very unfavorable, and by so much the more the greater the structural alterations which this part has suffered, either by thickening and induration, or by actual loss of substance (perforation). It is only in a few cases that a return to a normal condition (translucency, concavity, and repair of the loss of substance of the membrana tympani) is possible, and it is only with this return that recovery of the hearing can take place.

The prognosis of the simple form of chronic inflammation of the membrana tympani is least unfavorable when the disease is not of very ancient date, when the patient is still young (the interstitial changes yet active), and otherwise healthy, and the membrana tympani does not give the sensation of much hardness to the blunt probe. Under these circumstances we may hope for complete absorption of the interstitial exudation. Under opposite conditions we must be content with partial absorption, or with the removal of the chronic inflam-

mation and suppuration. The membrana tympani then becomes grey, dry, flat, insensible, indurated; cerumen is again secreted, and the hardness of hearing is improved to an extent that cannot be predicted with any degree of exactness. They are in the worst predicament in whom the deafness increases when the affected ear is cleansed by an injection, however gently performed: and when the loss of substance is associated with thickening produced by interstitial deposit, the prognosis is still more unfavorable.

Reparation of substance is accomplished with difficulty proportionate to the thickening of the membrane, and here (in opposition to what occurs in cases of perforation of the acutely inflamed membrane), there is always a visible cicatrix, which is depressed below the level of the membrane. Such a cicatrix always appears as a shining, whitish, translucent membrane, surrounded by the old membrana tympani, which is now white and dry, and seldom again resumes its normal appearance. Perforations, the edges of which are pressed against by the swollen mucous membrane of the tympanic cavity, and ulcers situated above the neck of the malleus, heal with extraordinary difficulty, and, indeed, in some instances they never heal at all. The prognosis is most unfavorable when the perforation of the membrane is accompanied by the already described extension of the inflammation, not only to the mucous membrane but also to the periosteum of the tympanic cavity, the dura mater, and even to the brain itself, in which case a fatal result is extremely likely to occur. When the tumefaction of the mucous membrane of the tympanic cavity is considerable, great difficulty is experienced in effecting a cure; whilst periostitis in this part must be recognised and subdued at once, if it is not to prove fatal to the patient by the uncontrollable rapidity of its extension to that lining the cavity of the skull.

Polypi of the membrana tympani must always be removed, care being taken so to destroy their roots that they cannot grow again. Those remedies must then be employed which have already been described as applicable to simple chronic inflammation and perforation of the membrana tympani (the basis of the polypi). The prognosis which may be derived from those polypi that grow so exuberantly from the mucous membrane of the exposed tympanic cavity, and are so exquisitely painful, is sufficiently worthy of notice, since they constantly indicate caries of the temporal bone, with all its dangerous consequences. Amongst the symptoms of cerebral mischief which belong to this disease, periodic or non-periodic rigors,

indicating suppuration in the cranial cavity, are the most remarkable, since they show that immediate danger to life, which cannot be averted, is to be apprehended. Still, cases sometimes, though very rarely, occur, in which paralysis of the corresponding side of the face (from periostitis of the temporal bone, extending into the Fallopian canal!), can be completely removed, and the life of the patient preserved. Caries of the temporal bone always produces complete deafness, whether the portions of dead bone be thrown off at once in the form of large sequestra, of which some remarkable instances are on record, or by imperceptible exfoliation.

As regards the treatment of chronic inflammation of the tympanic membrane, it is necessary, in the first place, to pay close and continuous attention to the local treatment, as this, in healthy constitutions, includes almost everything that art can accomplish for the relief or cure of the disease. At the same time, where there is any constitutional affection the treatment of this must not be neglected. The unjustifiable admission by some authors of a constitutional dyscrasia (scrofulous), which they consider accompanies all chronic discharges from the ear, especially in the young, leads to great harm by inducing neglect of the local treatment in order that the "discharge may not be suppressed," and to a blind reliance upon the good effects of alterative antiscrofulous remedies, which are certainly unable to check the disorganization, much less to effect the repair of the chronically inflamed membrana tympani. On the other hand it is unquestionably right to place those patients who present well-marked signs of a scrofulous, herpetic, or any similar dyscrasia, under appropriate and special treatment, both dietetic and therapeutic. Local remedial means must at the same time be most carefully applied, for, as we have already shown, they are amply sufficient in otherwise healthy persons to lead to the cure of the chronic inflammation. Scabs and crusts should first be softened with warm water and then gently removed, after which one or both ears, as the case may be, must be thoroughly cleansed by warm water, once or twice a day, according to the quantity of the purulent secretion. A vulcanized india-rubber syringe, equal in size to the fist, is to be used for injecting, and the stream should be thrown directly upon the inflamed membrane. The point of the syringe must, consequently be introduced to at least the depth of half an inch into the meatus, so as to pass the anterior curve and occupy the middle of the meatus, when the stream will strike full upon the membrane, and completely remove all secretion.

If the relatives of the patient are very timid they are not fit to perform this operation; intelligent people, on the other hand, will accomplish it very satisfactorily, even in young patients, for they can conveniently hold the syringe, filled with water, in the left hand for the left, and in the right hand for the right ear, and with light pressure propel the fluid into the meatus. After the injection, the head being inclined to one side, the ears should be thoroughly dried with soft old linen, and then plugged with soft linen charpie. Sometimes after the injection, pain, hardness, and swelling (inflammation of the connective tissue?) occur in the tragus and orifice of the meatus, necessitating the employment of a soft and thick camel hair brush for the purpose of cleaning out the latter. These symptoms are generally soon removed by the application of warm bread or linseed-meal poultices, and, in trifling cases, by stopping the ear with a plug of fresh fat pork. The patient must abstain from all stimulants and fatiguing corporeal exertion. He must avoid cold baths in summer, and must sleep warmly covered in winter. If we have only to deal with simple chronic inflammation of the tympanic membrane, we shall find the quantity and fetid odour of the abnormal secretion from the ears materially diminished by the daily injection of warm water, or by the use of the brush, which must be employed regularly for from eight to fourteen days. If the improvement ceases, the ear should be filled, after each injection, with a lukewarm solution of sulphate of zinc (gr. j—x, ad Aq. $\frac{3}{2}$ j), gradually increasing the strength; or, as is frequently advantageous, we may alternate this with a solution of acetate of lead (gr. j in Aq. $\frac{3}{2}$ j; a larger quantity of the acetate of lead does not dissolve, and therefore does not act properly on being applied to the inflamed membrana tympani); these solutions should be allowed to remain in the ear for about five or ten minutes. After they have flowed out, the ears are again to be thoroughly dried with soft linen and plugged with soft linen charpie. As a general rule, after this treatment has been persevered in for some weeks or months, the redness of the membrana tympani disappears, the abnormal secretion vanishes, the long suppressed ceruminous secretion returns, and the hardness of hearing diminishes proportionately to the absorption of the interstitial exudation in the membrana tympani, and in proportion, also, to the return of its natural concavity, transparency, and normal brilliancy. But if the progress of recovery be again checked, it will be wise to omit for a few weeks the dropping in of these solutions, and to rest satisfied with the daily

thorough cleansing of the ear with water, rather than to apply any solutions of alum, nitrate of silver, corrosive sublimate, sulphate of copper, or the like. It is at this time that we may make use of counter-irritant plaisters (Empl. Lithargyri comp. ʒij, Potassio-tartrate of Antimony, ʒj, Ol. crotonis gtt. vj), cut to the size of a dollar, and applied about two fingers' breadth below the affected ear till suppuration takes place. Blisters of cantharides are of little service in inflammation of the membrana tympani. They are a valueless remedy bequeathed to us from the time when the nature of aural diseases was wholly unknown. If exacerbations occur in the course of chronic inflammation of the membrana tympani, in consequence of exposure to cold, or other injurious influences, accompanied by more or less severe pain, and diminution or entire stoppage of the purulent discharge, we should intermit the injections or the brushing out of the ears, and, as in the treatment of acute inflammation (see above, p. 60), the ears should be filled several times a day with warm olive oil, and a sufficient number of leeches should be applied in front of or below them, and sustentative treatment and rest be prescribed, until the pains entirely disappear, the abnormal secretion returns with its former character, and the increased redness and sensibility of the membrana tympani again pass away. It is then time enough to return once more to the above-described treatment for the complete cure of the chronic inflammation. When, although considerable improvement has taken place, the membrana tympani remains white, opaque, and thickened, and the accompanying hardness of hearing still considerable, it is unfortunately seldom possible to effect the absorption of the interstitial exudation in the layers of the membrana tympani by the employment of either local or general means. The activity of the interstitial changes which take place in youth alone permits us to hope for improvement in these symptoms in the course of a few months, after the cure of the chronic inflammation has been accomplished; if this fail, or be retarded beyond the expectations or the exigencies of the patient, perforation of the thickened membrana tympani has sometimes been performed, in order to permit the waves of sound to gain entrance to the tympanic cavity, and to the labyrinth. Deleau assures us indeed, that, by means of his punch-like instrument, which is provided with a sharp-edged disk, he has bored through even an ossified membrana tympani and removed a round portion from it. Bonnafont lays claim to the same operation, which he performs with his similarly constructed

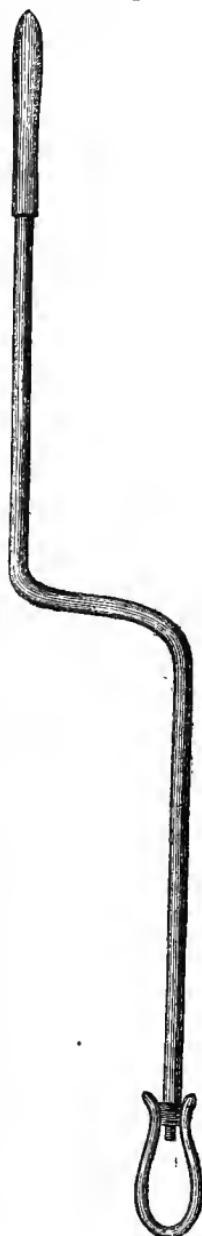
instrument ("il suffit pour perforer une membrane si dure qu'elle soit"); but if we are unable to bore through the indurated and thickened membrana tympani by means of a well-tempered cataract needle, we may consider these assertions as but little worthy of credit, and that the perforation of the membraue, when thus degenerated, is impracticable. If we reflect also upon Bonnafont's statement, that artificial perforations of the tympanum, in spite of being from 3—4 mm. in diameter, had without exception, closed up under his eyes ("l'ouverture du tympan se fermait toujours"), although he declares he has performed this operation upon several hundred patients, we lose, and we think justifiably, all confidence in the results of this much vaunted operation; and lastly, if we take into account the circumstance that in chronic inflammation of the membrana tympani, interstitial exudation (very rarely free) has, without exception, been proved to be present in the middle ear, by means of catheterism of the Eustachian tube, and recollect the important share, not to be removed by perforation, which the indurated and thickened membrana tympani has in producing deafness amongst such patients, we shall, especially after what we have already said of our mistrust in the results of this operation, consider it in these cases at least, perfectly impracticable. Perforation here, therefore, appears to be, not only almost incapable of being accomplished, but even, if accomplished, perfectly useless.

If we have convinced ourselves by means of catheterism of the Eustachian tube, of the presence of free exudation, which however is very unfrequent, or of free and interstitial exudation in the middle ear, in cases of chronic inflammation of the membrana tympani (see below), the time has arrived, the cure of the latter having been accomplished, to consider what means can be employed for the removal of such exudation, and thus to effect an improvement in the hearing. These means we shall presently describe. We shall also take the opportunity of treating of the palliative effects of "pads or balls of cotton" when the perforations of the chronically inflamed membrana tympani are under discussion.

When the chronic inflammation of the membrana tympani has been treated, in the manner just described, by perforation, we must pay particular attention, in the requisite daily cleansing of the affected ear, to the prevention of the entrance of the injection into the nose and mouth. This is extremely unpleasant to the patient, and sometimes produces fainting. We should take care therefore,

that the stream of water is directed, not against the membrana tympani itself, but against the wall of the meatus, near the membrane, and always with great gentleness. In this way, whilst the ear is effectually cleansed, the entrance of the water into the nose and mouth, and the vertigo are avoided. If, however, it should still continue, we supply the place of the injecting syringe, by brushing the meatus out with a fine camel-hair pencil; this can be readily and conveniently introduced even in young patients, as far as the membrana tympani, and they can easily learn to clean out the meatus with it for themselves. When, by one means or the other, we are certain of the thorough cleansing of the affected ear, we must pour into it once, twice, or three times a day, a lukewarm solution of sulphate of zinc, containing from 1—4 grains in $\frac{3}{4}$ of water, perhaps alternating it with a similar solution of acetate of lead (gr. 1—2 in aquæ $\frac{3}{4}$). These should be retained in the ear from ten to fifteen minutes. If the solution flows out through the mouth and nose, which indeed but seldom occurs, the diseased membrana tympani should merely be touched with a soft camel-hair brush dipped in the solution. This treatment will lead to the cure of the inflammation, and, in some very rare cases, to repair of the loss of substance at the point of perforation, but it must be patiently and persistently continued for months or even for years. Suppuration at length ceases, the membrana tympani becomes white, and exhibits at its deepest point, which is shining and white, the cicatrix of the original perforation. The recovery of the hearing, which accompanies this process of repair varies very much in degree, and cannot be predicted. If the cure of the perforation cannot be effected by these means, its edges, if it do not exceed the size of a pea, should be touched with very fine powder of sulphate of zinc (either pure, producing a subsequent feeling of pain, or mixed in various proportions with sugar) by means

FIG. 5.



of my "porte caustique" for powders (Fig. 5), whose platinum point, when moistened, will take up any desired quantity of zinc powder, and when introduced through the aural speculum can be applied with precision to the seat of disease. If a fine camel hair brush be applied to the point of the instrument, it serves excellently for the application of the powder to the edges of the perforation, which then gradually approximate; in favorable cases the opening ultimately closes, by the formation of a concave, greyish-white, and smooth cicatrix. Neither nitrate of silver, applied in the solid form, in powder, nor in solution, nor laudanum (Sydenham) nor any other means promote this process of healing so well as the method just described. We may await it in vain, in all cases of perforation, when there is much swelling of the mucous membrane of the tympanic cavity, and in ulceration above the collum mallei. If after the inflammatory process in the perforated membrana tympani has been wholly subdued, the membrane itself remains white and dry, the healing up of even the smallest perforations is never observed to take place. With the exception of these cases, Bonnafont errs in denying the perfect cure of those perforations which are produced by inflammatory processes; for in acute inflammation of the membrana tympani this is the rule, and it is by no means a very rare event, even in chronic cases. Swelling of the mucous membrane of the exposed tympanic cavity, ought not to be treated with caustics, nor even with powdered zinc, and certainly not with nitrate of silver, in substance at least, if we are desirous of avoiding violent pain, and very considerable inflammation of the subjacent periosteum. In these, as in cases of extensive loss of substance, sometimes amounting even to complete destruction of the membrana tympani, which are unfortunately only too numerous, we must generally give up all expectation of perfect recovery. We can then only thoroughly cleanse the affected ear, seek to diminish the purulent secretion by the use of mild solutions of zinc, and by a judicious regimen endeavour to remove every source of congestion or irritation from the ears. These considerations must engage the attention of the patient often for many years, or even throughout life, if he is desirous of staving off the development of acute inflammation in the ears and neighbouring parts, which, once lighted up, may possibly even prove dangerous to life itself. Should this serious condition however, be established, as indicated, by the above described symptoms of periostitis, of inflammation of the dura

mater and of the brain, it becomes absolutely necessary to adopt a most active and energetic local antiphlogistic treatment, in order to prevent the formation of pus in the cranial cavity, and its almost certain fatal issue.

To further this end, the patient should be kept in bed, with the head raised on horsehair pillows, (which give a sensation of agreeable coolness,) and inclined to the affected side, so that the discharge of matter may be facilitated. The room should be kept at a moderate temperature, the diet should be low, and no stimulants should be given. The bowels should be kept very freely open by salines with jalap and calomel. The affected ear should be thoroughly cleansed by the injection of lukewarm water, and if the discharge of pus be much diminished or suppressed, filled with warm oil, or even covered with a warm bread or linseed-meal poultice, until the discharge reappears, and the pain in the ear ceases. From four to eight leeches should be applied around the ear, and repeated, if requisite, each time permitting a more abundant flow of blood ; at the same time ice should be applied to the vertex, or still better to the occiput, until the pains in the ear and in the head have wholly ceased, and the paralysis of the muscles of the face and arm has entirely disappeared. When this is effected, we may employ a strong counter-irritant plaster, composed of Ant. Pot. Tart. 3j, Empl. Litharg. co. 3ij, Ol. Crotonis gtt. x, of about two inches square, which should be applied below the ear, or upon the neck, until numerous pustules have formed. The suppuration should be kept up for a considerable period. I have obtained exceedingly good results by these means, in cases where the cerebral symptoms have been very serious, and have also seen great benefit derived from the simultaneous application of emollient bread poultices upon the ear, and ice to the occiput, continued through the day and night. When the patient can endure the vibrations and shocks of the head produced by riding, walking, striking it with the knuckles, &c., we must discontinue the use of these powerful remedies, and return to the treatment which I have already detailed for chronic inflammation of the perforated membrana tympani.

The occurrence of daily, or of still more frequently repeated rigors (pyæmia), typhus fever, vomiting, and similar symptoms, in association with paralysis of the facial muscles, with violent pain in the ear, and especially in the head, indicate that the disease is perfectly hopeless. We can only look forward to the death of the patient as certain, life usually passing away with the supervention of con-

vulsions or deep coma. Fortunately, however, this disease has but rarely any tendency to a fatal issue.

If we now turn to the very numerous cases in which, on account of extensive loss of substance, or remarkable degeneration of the still remaining membrana tympani, or on account of considerable swelling of the exposed membrane of the tympanic cavity, with chronic inflammation of these parts, there exists a well-marked degree of deafness which cannot be removed, we may well imagine the frequent and earnest wish, the longing for the improvement of the hearing that these unfortunate patients feel; and when we further reflect that in a considerable proportion of cases, when the difficulty of hearing has been very great, sudden and repeated improvement has occurred after a variable period, from some unknown and inexplicable cause, we are clearly not in a position to deny the possibility of a radical cure, nor to advise the patient to resign himself calmly to the sad condition of complete deafness. It is in these cases, therefore, that the contrivances of moistened pieces of cotton wool (Yearsley), and the artificial membrana tympani (Toynbee), have been hailed with enthusiasm. To follow out the former plan, a little piece of wadding, after having been dipped into warm water and lightly squeezed, is rolled between the fingers into a ball of the size of a pea. With the aid of a rounded pair of forceps, this is introduced as far as the chronically inflamed (entire or) perforated membrana tympani in such a manner that it does not completely occlude the opening in the membrana tympani. "The little ball is now introduced through the speculum, and adjusted superiorly, inferiorly, anteriorly, or posteriorly, according to the situation of the perforation; immediately after it has been placed in position, a very marked improvement of the deafness will be produced." We have now accomplished the application of these "ear spectacles" (Erhard), and though it cannot be denied that the little piece of cotton-wool effects an improvement in numerous cases of chronic inflammation of the membrana tympani, yet it must also be acknowledged that in very many cases of this disease it wholly fails. In many cases also it will be found impossible to adjust the ball of cotton to the perforation, except after numerous futile attempts, whether the forceps are introduced by the surgeon in attendance, or, as is most frequently the case, by the patient himself. Moreover, supposing the ball of cotton to have been placed in the right position with more or less trouble, a new difficulty

arises ; for it only maintains its position so long as it remains moist, a difficulty which is not trifling when the vertical position of the smooth membrana tympani is considered. Hence it often happens that in such movements as those of speaking, mastication, yawning, dancing, or jumping, the little ball suddenly becomes detached, and there is a consequent immediate return of the deafness. This effect is also produced as soon as the ball becomes dry ; it then becomes necessary to remove and moisten it, and, with a repetition of the same troublesome manœuvres, to attach it to the same spot. The difficulties which stand in the way of applying this remedy, and want of patience on the part of the patient, render it almost impossible to give relief by these means, and the mechanical irritation produced by the ball upon the inflamed membrana tympani, and still more upon the exposed and inflamed membrane of the tympanic cavity, is a very serious additional inconvenience—an inconvenience which may perhaps be somewhat alleviated, but certainly cannot be wholly removed by soaking the ball in a solution of acetate of lead. I have seen very considerable increase of the inflammation, enlargement of the perforation, and increase of the deafness result from its use, so that, upon the whole, I consider the moistened ball of cotton-wool, so far as regards that form of deafness which accompanies chronic inflammation and perforation of the membrana tympani, a very uncertain palliative, applied with difficulty, and easily producing injurious effects.

I have observed the injurious effects of the ball of cotton-wool not only in those cases when the membrana tympani was entire, but when it was wholly destroyed, with the loss of the three ossicula, and also in those instances where only partial destruction had taken place. The same remarks may be applied to the operation of the "artificial membrana tympani," which Toynbee recommends to be used in cases where the membrane is perforated. This is a round, very delicate plate of vulcanised India rubber, about three quarters of an inch in diameter, which, supported by a thin silver wire attached to its centre, is to be introduced in a moistened state into the ear, and applied in such a manner to the perforated membrana tympani, that it shall close the orifice "air-tight, the patient being in the meanwhile in no way incommoded, and the mucous membrane of the cavity of the tympanum nowhere touched. The hearing will be immediately found to be greatly improved." That an "air-tight closure" for an opening in the membrana tympani can be effected by

the application of a soft caoutchouc membrane, every unprejudiced person will admit to be an impossibility; moreover, the exact spot of the membrana tympani, on touching which the hearing is remarkably improved, can only be discovered by some manœuvring of the artificial membrane. It is as difficult to maintain in its position as the ball of the cotton-wool. Both slip with equal ease, and then the improvement of the hearing as completely disappears as when they become dry. But, lastly, the mechanical, injurious irritation, which the artificial membrana tympani exercises upon the inflamed membrana tympani, to which it is applied, is yet greater than that of the ball of cotton wool, so that, in my opinion, of the two palliatives, the cotton-wool is preferable to the artificial membrana tympani. Both, however, require to be applied with caution, and careful observation should always be directed to the premonitory symptoms of increased inflammation of the membrana tympani and of the membrane of the tympanic cavity.

The attempts hitherto made to explain the action of the moistened ball of cotton-wool, and of the artificial membrana tympani in improving the hearing, completely fail, since on the one hand the organic conditions which enable them to operate are very imperfectly known, and on the other hand our information respecting the acoustics of the ear is extremely imperfect.

The chronically inflamed membrana tympani, whether it be perforated or entire, may be covered either partially or entirely with a flat, soft, elastic, and easily bleeding tumour, of a bright-red colour, presenting a smooth or granular surface, and usually painless. The treatment to be adopted is to touch it every day or less frequently, lightly or freely, according to the sensitiveness of the tumour and of the patient, with pure sulphate of zinc in powder, or with a little admixture of sugar, or more rarely with nitrate of silver in powder. These may be applied by taking a little up on the moistened point of my "porte caustique for powders" (see Fig. 5, p. 71), until the tumour disappears. When the deep red and apparently prominent surface of the membrane feels hard upon touching it with the blunt probe, whether it be painful or painless, the application of every kind of caustic is contraindicated, as they would only act injuriously upon the ossified or cartilaginous membrana tympani. We must consider this condition of disease as wholly incurable.

If the outgrowths of the chronically inflamed membrana project as pedunculate or capitate polypi, it will depend partly upon their pro-

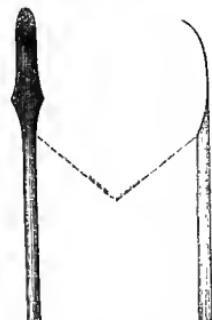
minence and partly upon the manual dexterity of the surgeon, whether they should be removed in the way above described, by means of caustics, or whether the knife, scissors, or ligature should be employed.

Very nervous patients who dread the knife, readily decide in favour of the ligature, which indeed is to be preferred to cutting instruments for fibro-cartilaginous polypi. In either case, however we should always first pass a blunt silver probe completely round the tumour, in order to convince ourselves that it has not coalesced with any part of the meatus, and that its root does not originate from this instead of from the membrana tympani. When this has been ascertained, the head of the polypus should be seized as low down as possible, with a sharp pair of forceps, pulled strongly outwards, and the curved (on the flat surface) double-edged, round-pointed knife (see Fig. 6) introduced along its side deeply into the meatus; the stalk of the tumour can then be cut through by one or two sawing movements of the knife. If its texture is fibro-cartilaginous, on the other hand, it will be cut through much more easily with the scissors than with the knife; these instruments (Fig. 7) should also be curved and blunt, and introduced as deep as possible, towards the root of the polypus, then opened, the stalk included between the blades, and with one or more strokes severed. The separated portion may be removed by means of a hook. When the after bleeding, which may be pretty free, has been stopped, the affected ear should be injected and we should ascertain the size and position of the root of the polypus, in order that, according to the particular circumstances of the case, the application of sulphate of zinc or of nitrate of silver may be made either day by day, or less frequently, until the last visible remnants of the polypus are destroyed.

The thin end in which my porte caustique or caustic powder carrier terminates, allows of the application of caustics to a limited spot, with great precision and with complete safety to the adjoining parts.

When we are desirous of employing the ligature for the removal of a polypus, we use a diminutive "Leveret's ligature canula" (see Fig. 8, natural size) with a fine silver wire attached, having a sufficiently large loop, to allow of its introduction over the forceps

FIG. 6.



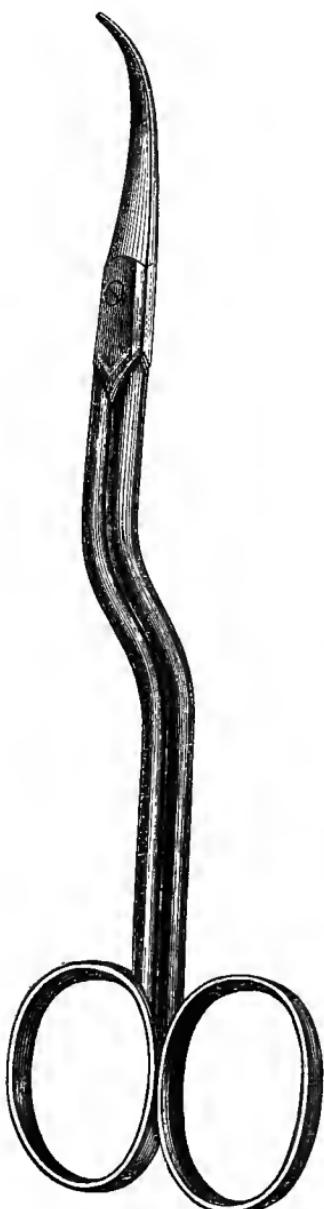
and the head of the polypus. This should be passed deeply into the meatus towards the root of the outgrowth, and having encircled it, the loop should be drawn tight, the two ends of the silver wire being

fastened to the small lateral rings. The whole instrument should now be twisted a few times upon itself, until we feel a slight resistance. The stalk of the polypus is then girt with sufficient tightness. As this instrument is very small and light, it hangs from the meatus without producing any inconvenience to the patient. After a few days the polypus becomes brown or blackish, the discharge very fetid, and the pedicle nearly severed, so that it only requires a slight pull to divide it entirely from its root. When it is not so, the ligature should be tightened by twisting the cauula a few more times upon itself, when the polypus will certainly fall off in a day or two at farthest. We have now once more only to take care that the root of the polypus is completely destroyed by the application of the caustic powder.

It is perhaps hardly necessary to state here expressly that the application of caustic, especially to the flat polypi, to the short-stalked tumours, and to the roots of the long-stalked tumours springing from the membrana tympani and meatus, should only be made with good sunlight illumination and the use of my aural speculum.

When we have removed the last traces of the aural polypi by these means, we have only to deal with their original cause—the chronic inflammation of the entire or perforated membrana tympani. This demands exactly

FIG. 7.



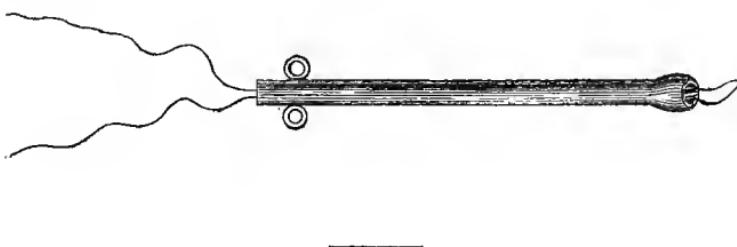
the same treatment which has been above given for the well-marked forms of this inflammation. When the polypi are of a rounded form and project from the meatus, we may seize and drag them out at once with forceps. This is, indeed, a somewhat rough procedure, but not to be despised in robust individuals, and is to be followed by the already frequently described application of caustic to the remains of the root. We have already referred to certain capitata polypi, which are extraordinarily sensitive to the slightest touch, root themselves in the tympanic cavity—exposed in consequence of perforation of the membrana tympani—and are constantly accompanied by caries of the temporal bone, which has either already affected the dura mater, or threatens to implicate it. Aural polypi of this kind are completely inaccessible; and it is useless to attempt to remove them by knives, scissors, ligature, forceps, or caustics, if we are not desirous of greatly increasing the deep-seated inflammation so dangerous to life. They appear and disappear with the periostitis in the tympanic cavity, and the resulting caries of the temporal bone, for which the treatment above given must be adopted (p. 73).

To the foregoing description of the diseases of the membrana tympani, I may be permitted to add a few words upon the appearances which not unfrequently present themselves in the ear, and subsequently in the membrana tympani, after exposure to near and violent explosions of artillery, after a fall upon the head, or after severe blows upon one ear or upon one side of the head. In such cases a continued discharge from one or both ears may be observed for days or even for weeks, consisting in the first instance of blood, then of a sero-sanguinolent, and finally of an apparently pure serous fluid. When the patient escapes with life, the discharge gradually and spontaneously diminishes; but if with the discharge there is complete deafness, we believe it must be regarded as an unfavorable sign, indicating fracture of the temporal bone, and in particular of its petrous portion. However, as the membrana tympani has never been thoroughly examined during life in any of these cases, we can only doubtfully consider that the discharge proceeds from the torn blood-vessels of the membrana. When the discharge is abundant, it probably proceeds from the cranial cavity, and especially from the arachnoid, since in one case of this kind the fracture was found to pass through the membrana tympani and the petrous portion of the temporal bone.

The treatment of these cases is limited to keeping the head in-

clined, so as to facilitate as much as possible the discharge of the fluid. Whatever further measures are requisite must be suggested partly by a careful examination of the membrana tympani, and partly by the presence or absence of symptoms indicating cerebral disturbance.

FIG. 8.



CHAPTER II.—DISEASES OF THE MIDDLE EAR.

THE middle ear includes the Eustachian tube, tympanic cavity, and mastoid-cells ; but we shall here only take into consideration the diseases of these parts as they occur with an imperforated membrana tympani. Those forms of disease which present themselves with perforation of the chronically inflamed membrane have already been fully discussed in the previous chapter.

At the outset, then, we may observe that the diseases of the middle ear are completely inaccessible to ocular inspection, which is so important in enabling us to form a correct diagnosis ; for the normal transparency of the membrana tympani will not permit us to penetrate further, at least with any precision, than the handle of the malleus. This is the more to be regretted as the diseases of the external ear are rather less numerous than those of the middle ear (427 : 560, see table), and the diagnosis of the latter is of great importance ; in order that we may avoid rashly assuming the existence of “nervous deafness.” The symptoms which we can observe by the senses of hearing and touch are of the greatest value in the investigation of the various morbid conditions of the middle ear ; but these can only so far furnish a scientific character to the diagnosis as they are observed by the surgeon, and not by the patient, or in other words, as they possess an objective value. In this respect, Valsalva’s experiment, which consists in making the patient propel air into his ears, by a forcible expiration, while the mouth

and nose are closed, utterly fails. The success of this experiment depends upon the address of the patient, and his knowledge of what he is expected to do; and even in favorable cases only a weak sound ("thug") is produced, which is of very short duration, and only proves that there is a passage through the Eustachian tube, that it is not altogether closed up. But this is almost equivalent to proving nothing at all, since the tube never closes up entirely, or so rarely that it can scarcely be numbered in the category of aural diseases. Amongst 500 individuals suffering from diseases of the middle and inner ear, and whom I have repeatedly catheterised, I have never once observed it, though I certainly suppress two such cases which occurred to me thirty years ago, at the period when I first devoted myself to the study of aural surgery.

The ear catheter constitutes an essential improvement in the mode of investigation, but if we blow air through it into the ear, or conduct compressed air into it, and then rest satisfied with asking the patient what he feels or hears, so that our decision upon the results of the experiment is subjected to the judgment of the patient, the value of the symptom as a means of diagnosis is immediately lost. But if we put our ear to the ear of the patient, during the passage of the compressed air; or if we connect, at the time of the passage of the air through the catheter, the ear of the patient with our own by means of an elastic tube, this method of inquiry entirely loses its subjective and uncertain character and never presents any variation in the objective and acoustic phenomena.

Those physical signs which characterise the various diseases of the tube and of the tympanic cavity, may best be perceived by employing catheters of gradually increasing calibre, as from 1—4 (see Fig. 2, p. 26, sections 1—4), by which a corresponding increase of strength in the stream of air blown into the Eustachian tube is obtained. By the use of the elastic tube (Fig. 3, p. 30) the surgeon is enabled himself to form accurate conceptions of the objective symptoms. The operation of blowing air through the Eustachian catheter should therefore always be accompanied by the use of this tube. The air should always be blown in by the mouth of the surgeon and not driven in by either large or small compression machines, for it is then of an agreeable temperature, and the insufflation can be conveniently prolonged or repeated, whilst it is easy to hold the catheter firmly and steadily in position. It is very rare for obstacles of a

mechanical nature to present themselves in the middle ear which cannot be overcome by a person blowing against them, providing he has sound lungs, which are indispensable to an aural surgeon.

The mode of introduction of the catheter into the tube has been already (see p. 28) carefully detailed, and it will therefore only here be briefly referred to. The blowing in of air is best accomplished by slowly increasing the pressure, so as to prolong the period of observation, and enables us to ascertain accurately the strength of the obstructions which have to be overcome in the middle ear.

If we blow into the Eustachian tube of a healthy person, through the smallest catheter (No. 1), we hear, not in the ear of the patient, but as though in our own ear, a full, clear, soft, and somewhat moist rushing sound, which lasts as long as we continue to blow into the catheter, and which increases or diminishes with the changes in the strength of the blast.

The air blown into the tube appears to be driven into our own ear, through the diagnostic tube, so that we can indicate, for the sake of brevity, this acoustic evidence of the free permeability of the middle ear, by the expression "the air passes." Every departure from this normal state, either in the size of the catheter required, in the full and unbroken character of the stream, or in the sound of the air blown in, depends upon, and indicates changes in the size, and in the activity of secretion in the middle ear. If, for example, the air only penetrates through catheter No. 1 by fits and starts, but easily through No. 2, or only through Nos. 3 and 4, or lastly not even through these, we possess in this progressive increase of difficulty in surmounting the obstruction, an objective symptom of a determinate nature, furnishing information of the relative decrease in the calibre of the tube resulting from interstitial exudation. If no air can be driven through the catheter into the tympanic cavity, but the instrument remains in position in the Eustachian tube, we hear through the diagnostic tube, distantly as it were, in the ear of the patient, a more or less dull, but always dry, rushing sound, which enables us in some measure to recognise the position of the constriction as nearer or further from the tympanic cavity. The subsequent introduction of the catgut or bougie, will then supply us with more exact information.

On the blast of air gaining admission into the cavity of the tympanum, that is to say, when it passes apparently through the diagnostic tube into the ear of the observer, we hear, when every-

thing is in a healthy condition, *a clear, soft, full sound*; in abnormal conditions this sometimes becomes hard, sharp, and dry, sometimes moist, loose, rattling, and mucous, sometimes dull, without resonance, and more or less attenuated—variations which indicate with great exactness corresponding changes in the secretion, in the secreting surface, and in the capacity of the tympanic cavity. When we introduce into the healthy Eustachian tube of an adult a catgut or caoutchouc bougie (about one millimètre in diameter, on which the length of the catheter is marked, with another mark at the distance of one inch and a half showing the length of the Eustachian tube) we find that it glides easily along without any pain, let, or hindrance for one inch and a half till it reaches the entrance into the tympanic cavity. On pushing it still further—but varying in different people from half a millimètre to four mm. from its entrance into the tympanic cavity—pain of such an extremely acute character is produced that we are obliged to withdraw the catgut or bougie immediately. Usually, withdrawal to the extent of half a millimètre is sufficient to produce entire cessation of the pain. Whether this is produced by contact of the catgut with the membrana tympani (to which it is conducted) or with the malleus or stapes it is impossible to determine, nor is it practically of any importance, since it is perfectly useless to push the catgut or bougie into the tympanic cavity beyond the entrance of the Eustachian tube. The pain just described is infinitely more acute than that which is experienced when the catgut or bougie is forced through a stricture of the tube.

When an obstruction is presented to the further introduction of the bougie it indicates the point of constriction, a point the distance of which from the guttural and tympanic openings of the tube can be most accurately ascertained by the marks on the catgut or bougie. Not unfrequently, upon overcoming one obstruction, we find a second beyond it. We are able to ascertain when these constrictions are circular and narrow by the slipping through of the catgut, which is somewhat compressed as it passes through them, whilst a broad constriction, or a general swelling of the mucous membrane of the tube throughout its whole length, gives quite a different kind of sensation to the fingers, at least when these are endowed with high tactile sensibility. Bonnafont assures us that he has passed elastic bougies up to one and a half millimètres in diameter for the dilatation of the constricted portions of the tube, but

this is hardly credible, as he in another part of his work states "j'y introduis chaque jour des bougies dont le diamètre ne peut jamais dépasser 1 millimètre."

If Erhard admits the value of these tactile symptoms as evidences of stricture of the Eustachian tube, we may well ask why he should describe the sounding of the tube by the catheter as "a useless and troublesome proceeding," but he confesses that it has never been in his power "to introduce the sound deeper than two or three lines beyond the end of the catheter in a healthy Eustachian tube." Now, he may certainly attribute this either to his own want of manipulative dexterity or to the bad construction of his instruments, and should not judge of others by himself. I at least scarcely know of a single case, during an experience of more than twenty-five years, in which I have been unable to introduce catgut or other bougies of sufficient fineness until a painful impression was produced by their contact with the membrana tympani.

By these means of research, derived from the senses of hearing and touch, we are able to recognise objectively, not only the normal conditions of the middle ear, but also its abnormal states, in reference to the structure and secretory activity of its walls, under the forms of—

- (a) Suppressed,
- (b) Free,
- (c) Free and interstitial,
- (d) Exclusively interstitial exudation.

These are well-marked forms of catarrhal inflammation of the investing membrane of the tympanic cavity and Eustachian tube either closely resembling or identical with those which may be observed in the mucous membrane of the respiratory tract, so that we can very well dispense with the proofs of their existence derived from actual dissection, which, indeed, have never yet been obtained.

"Membranous bands, ankylosis of the ossicula between themselves or by means of ligamentous bands with the promontory, ankylosis of the stapes into the fenestra ovalis, thickening of the periosteum of the tympanic cavity and of the membrane of the fenestra rotunda in particular," and other similar diseased conditions of the tympanic cavity observed upon dissection, cannot certainly yet be diagnosed by my acoustic and tactile method; but as all these results of post-mortem examination have been found only in the

bodies of those who have died from severe exanthematous, typhus, and gastric fevers, in dropsy, jaundice, and other similar diseases, which effect important alterations in the nutrition of mucous membranes in general, it becomes a question whether they are not entirely the products of these diseases when they have proved fatal; and still more questionable whether they are to be assumed to be present in the very numerous cases of hardness of hearing in which these severe constitutional affections have not attacked the patient. This doubt is greatly strengthened by the circumstance that such pathological conditions have never been objectively diagnosed during life, nor have they and the deafness ever been shown to stand in the relation of cause and effect. On this account it appears to be somewhat precipitate to enumerate these results of dissection amongst the diseases of the middle ear, and we are still less justified in including, with Erhard, "induration and hypertrophy of the ossicula," for the evidence of which he appeals to Toynbee's 'Reports of Dissections.' But Toynbee never mentions any such morbid conditions. He found the membrane lining the tympanic cavity "thick, red, soft, vascular, swollen, and pulpy," but never "indurated." Erhard thus fails as prominently in establishing a physical diagnosis for his "induration and hypertrophy of the ossicula" as he does in his other hypothetical diseases of the middle ear, a deficiency which he seeks to supply by proposing a functional diagnosis, or, in other words, a diagnosis derived from or depending upon the functions of the ear, which he forthwith declares to be "apodictically certain," that is, absolutely certain, though he again modifies this statement by saying "that the functional diagnosis can almost (!) be called purely objective." If we examine more closely this very dubious explanation of the "functional diagnosis," we find that he lays down as its fundamental proposition "the absolute fact, the pathognomonic symptom," that "those who are deaf on both sides, with perfectly occluded meatus, hear the sound of a watch clearly and distinctly when it is pressed against the head," a proposition the incorrectness of which could easily be shown experimentally if Erhard had not himself already made so many important exceptions and limitations to it, that all "absolute certainty" has entirely disappeared.

Erhard, for example, excludes from these "persons deaf on both sides," all those who—

(1) Are of great age, in whom the power of conduction in the bones of the head is diminished.

- (2) In those above forty, and those who are no longer young (!) and are hard of hearing.
- (3) Those who have a strong diploë and thick integuments.
- (4) Those also who are nervously deaf, or
- (5) Those who are apparently nervous, and who suffer from reflex deafness.
- (6) Those who are deaf on one side only, amongst whom some may be able to hear a watch through the cranial bones of the affected side, the ear being, nevertheless, nervously deaf, with no morbid conditions in the middle ear, and therefore, not acoustically deaf.

When we reflect on the great number of these exceptions, it appears ridiculous to apply the term "apodictic" to a functional diagnosis resting upon no better foundation than the ability or inability of the patient, under certain circumstances, to hear the sounds of a particular watch.

Catarrhal inflammation of the Middle Ear.

This disease attacks the investing (serous) membrane of the cavity of the tympanum and (mucous) of the Eustachian tube, and is recognised by various changes which are produced in the processes of nutrition and secretion. The chief forms which present themselves, and which but seldom run into one another, are—

- (a) Cases of suppressed exudation.
- (b) Cases of free exudation.
- (c) Cases of free and interstitial exudation.
- (d) Cases of interstitial exudation.

The general symptoms of these different forms of disease are, that their course is tedious, being often protracted for months or years; the local inconvenience is exceedingly slight, rarely amounting to pain, and by no means persistent; occasionally, however, some pain is experienced. There is usually a gradual and progressive tendency to become worse, and the patient very seldom improves spontaneously, especially if there be a general febrile condition of the system. Nature does little towards the cure. There is no danger to life, nor is the ear organically affected, although its function is so seriously impaired. The deafness which constantly accompanies these affections is only to be explained on the theory already (*p. 7 et seq.*) given, that the conduction of sound takes place through the air of the tympanic cavity and the membrane of the *fenestra rotunda*. Free exudation in the tympanic cavity compresses the air normally con-

tained within it, and renders the transmission of the vibration of sound difficult in proportion to the inferior conducting power of the free exudation (*mucus*) as compared with air. If the surface of the membrane of the *fenestra rotunda* be covered with mucus, its power of vibrating will be lost, in exactly the same manner as when this little membrane participates in interstitial exudation affecting the lining membrane of the tympanic cavity. Interstitial exudation in the mucous membrane of the Eustachian tube produces constrictions of the tube of various degree and length; these interfere with the requisite renewal of the air contained in the tympanic cavity, which probably becomes rarefied, and therefore less adapted for the conduction of sound from the *membrana tympani*. The various grades of hardness of hearing owe their origin in many cases to these organic changes.

Notwithstanding the anatomical differences between the lining membranes of the tympanic cavity and of the Eustachian tube, it is impossible to separate these diseases in practice by any points of physical diagnosis, and it is therefore useless to attempt to define their differences on purely theoretical grounds.

The most important cause of the catarrhal inflammation of the middle ear is cold, though the time and manner of its operation cannot always be exactly determined. Sometimes the exposure to cold has been general, sometimes, and more frequently, local. Amongst the more common modes in which cold acts are cold draughts of air; the entrance of cold water into the ears in washing and bathing, and in shower and douche baths, &c.; cold and wet feet. Weak and unhealthy constitutions, such as the scrofulous, are especially susceptible to these inducing causes; but injurious influences, operating powerfully, or less energetically and more frequently, often produce severe attacks of catarrhal inflammation of the middle ear, even in persons who have been previously in excellent health.

The diagnosis of these affections is determined, in the first place, by convincing ourselves by ocular inspection, of the healthy condition of the external ear; and, secondly, by the physical examination of the middle ear, by means of the insufflation of air through a series of regularly graduated catheters and the use of the diagnostic tube. In certain cases it is further requisite to introduce bougies through the catheters.

The prognosis and treatment vary so much with the form that the disease assumes, that we can only state generally that constitutional

remedies are but rarely of service, and then only to a limited extent, whilst local measures applied directly to the Eustachian tube and the tympanic cavity are very effective in expediting the cure.

Catarrhal inflammation of the Middle Ear with suppressed exudation.

This disease usually commences during or immediately after a violent cold in the head. It sets in with a sensation of great fulness, hardness of hearing, and loud noise in one or, more frequently, in both ears. These symptoms continue without any cessation for several weeks or months, and are generally associated with various abnormal sensations, as loud rushing noise or deceptive musical sounds, which may be either limited to one or two notes or range over a scale of greater or less extent.

In these cases we find the meatus and membrana tympani healthy ; the throat vascular, somewhat swollen, but devoid of mucus. The chief general symptoms of which the patient complains are the cough and catarrh.

When, under these circumstances, air is blown into the Eustachian tube through No. 1 catheter, we hear it passing through the diagnostic tube, as it were, with a dry, sharp sound, into our own ear. The operation of insufflation not only effects no improvement in the symptoms, but actually produces an immediate and very decided increase in the hardness of hearing, noise, and sense of fulness in the ears ; this generally passes off after the lapse of some hours, the patient then returning to his previous condition. The more force is employed in performing the operation, and the more frequently it is repeated, the longer and the more serious is the increase in the severity of the symptoms, a proof that they proceed from mechanical irritation of the inflamed membrane of the tympanic cavity, such inflammation being the organic cause of this disease.

Diagnosis.—A full stream of air passing quite easily and freely, even through a No. 1 catheter, proves the completely normal size and space of the whole middle ear, that is to say, the absence of the smallest interstitial exudation in it, whilst the sharp, dry tone produced by the air in its passage clearly proves the absence of free exudation, and that even the normal sparing secretion which at other times makes the sound of air passing into the tympanic cavity appear soft has altogether disappeared. This cessation of secretory activity must obviously affect the whole of the membrane lining the tympanic

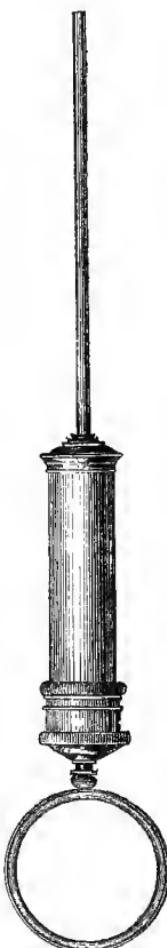
cavity, including, therefore, of course, the membrana tympani and the membrane of the fenestra rotunda; the capacity to respond to the vibrations of sound is therefore diminished in both, and a corresponding hardness of hearing is produced. As soon as the serous secretion in the middle ear is again restored, this symptom of disease completely disappears, together with the noise in the ears which so frequently accompanies catarrhal inflammation of the lining membrane of the tympanum, when the chorda tympani is implicated.

The prognosis is generally favorable, if the patient be not too far advanced in age.

In the treatment of recent cases attention must be paid to the accompanying general febrile condition of the patient, for which the usual well-known remedies should be employed; amongst these a few warm baths deserve special notice. When the mucous membrane of the pharynx is observed to be reddened and inflamed, whilst little or no secretion is present, mild emollient gargles of decoction of barley, &c., should be ordered, with the internal use of sal ammoniac in solution and mild mucilaginous drinks, until the suppressed secretion in the pharynx and on the gums returns. When the weather is cold and damp, the patient should stay at home, and the ears should be stopped with wool. These measures only operate indirectly upon the middle ear, by preventing injurious influences acting upon it from without, and especially inflammation extending to it from the throat.

Local treatment applied to the cavity of the tympanum itself is always indispensable, and is easily accomplished, since we have so ready a means of access to it through the Eustachian tube. The most appropriate remedy is a very diluted solution of liquor potassæ, containing about six drops to one ounce of water, of which about three or four drops should be warmed and thrown into the tympanic cavity. By means of a fine, long-tubed, injecting syringe (Fig. 9), we take up a little of this lotion, and allow a few drops to enter catheter No. 1 (whose funnel has previously been stopped by a cork), by the capil-

FIG. 9.



lary-like termination of which they are retained, so that they do not flow out when the catheter is introduced into the Eustachian tube through the nostril. When this has been accomplished with a steady hand, we remove the cork and blow quickly into the catheter, by which the fluid contained within it will be propelled through the Eustachian tube into the tympanic cavity, as is clearly shown by the air apparently passing through the diagnostic tube. As a general rule, the propulsion of the solution into the tympanic cavity at first increases the sensation of fulness in the ear (very seldom diminishing it). After some minutes or hours it returns again to its original condition. It is, therefore, necessary to be particular in not blowing in more than a very few drops at a time. In favorable cases the sense of fulness and heaviness in the ear are alleviated in the course of the same or of the next day, with simultaneous and corresponding improvement in the deafness. The solution is again to be blown in if either the improvement which was at first perceptible make no further progress or if scarcely any alleviation of the symptoms be experienced. The solution should never be reapplied until any increase in the fulness of the ear it may have caused has passed off, or, in other words, until the patient has again returned to his usual state. By careful attention to these precautionary measures I have seen in all the cases that have hitherto come under my care, though the application of the remedies has been extended over a very variable period of time, the fulness and noise in the ears, the hardness of hearing, over-acute hearing, or other disturbance of the faculty as regards the perception of musical sounds, more or less completely disappear: at the same time the sound of the current of air blown through No. 1 catheter, and passing through the Eustachian tube, gradually lost its abnormal dryness and resonant hardness, and became soft, which indicated that the healthy secretion in the tympanic cavity had returned. The cure was then considered to be completed. Throughout the whole course of the treatment we must take care not to blow with too much force through catheter 3 or 4, lest the powerful stream of air should increase the inflammation of the lining membrane of the tympanic cavity, and with it the weight and fulness in the ear.

Catarrhal inflammation of the Middle Ear, with free exudation.

This affection generally commences with sudden and well-marked hardness of hearing, occasionally accompanied with transient but

violent tearing pain. These symptoms may be limited to one ear, or, as is more frequently the case, occur in both, either coincidentally or in quick succession. Noise in the ears, varying in character and duration, is very often present, as may be seen by a reference to the table at p. 17. More or less considerable improvement is often experienced by the patient, even when the disease is wholly neglected, in dry, warm weather, or after violent physical exertion, producing profuse perspiration; after spontaneous or artificially excited vomiting; after violently blowing the nose whilst the mouth is closed, or any other similar cause; but such improvement is seldom of long duration, and is, perhaps, never more than partial.

The general health of the patient, with the exception of some catarrhal disorder, is usually good. Upon making an examination of the mucous membrane of the velum palati and throat, it often, though by no means constantly, appears red, swollen, and covered with mucus; the amygdalæ are tumid, and we not unfrequently observe a well-marked catarrhal inflammatory condition of all these parts, which may remain for weeks or months without any hardness of hearing. We cannot admit that there is any exact genetical connection between these diseases of the throat and the affection of the ear, though we may, perhaps, concede that the catarrhal affection of the throat may protract that of the middle ear, and increase the difficulty of cure. The meatus contains, with few exceptions, a proper quantity of cerumen, of a healthy soft consistence, and natural colour. In adults the membrana tympani is generally shining and translucent; in children it is, as it ought to be, semiopaque, less shining, with the handle of the malleus showing through it, and quite free from any interstitial exudation.

In catheterizing the tube, air can generally only be blown in through catheters No. 3 and 4, and some force is requisite. It then passes with a moist, rattling sound, and the patient immediately experiences very remarkable improvement in his hearing, both for vocal and other sounds. The noise in the ears, also, which was previously present, often disappears entirely in the course of an hour, and is far less distressing if it recurs. The entrance of a strong stream of air into the cavity of the tympanum generally produces, especially in young and excitable persons, a strong rigor, and the patient moves the hand to the head involuntarily, without experiencing any pain or being able to assign any reason for it. If the catheter No. 1 or 2 be used, the thin and weak stream of air which

passes through it may not be able to press its way into the cavity of the tympanum ; we can then only hear the air, which neither passes through the Eustachian tube nor reaches the membrana tympani, rushing at a distance, and we accordingly find there is no improvement in the deafness.

Occasionally, quite recent cases excepted, the improvement which occurs after the insufflation of air proves to be only temporary, but it may again be effected by repeating the operation, and always with gradually diminishing difficulty in blowing in air in greater quantity and for a longer time, until at last, in the course of some weeks (rarely months), the sound of the air blown in loses its moist mucous character, and becomes clear and soft, whilst the passage to the tympanic cavity itself becomes free, even for the thin stream of air blown in through catheters No. 1 and 2, so that we can hear it, continuous, full, and clear, passing through the diagnostic tube into our own ear. At the same time hardness of hearing and noise in the ears are completely removed, and the patient again feels himself perfectly well.

Sometimes this regular course of events is interrupted by some disturbing conditions, which may very easily embarrass the unpractised observer. Thus, sometimes, in particular, the already commenced improvement suddenly ceases, without any obvious cause, or even a retrocession may occur almost to the original condition of deafness, whilst upon strongly blowing in air it is directly perceptible that the sound of the stream is sharp, clear, and dry. The condition of suppressed exudation has now supervened, a condition of disease already described, and the treatment of which will be considered hereafter.

Diagnosis.—The impossibility of driving air into the tympanic cavity through catheters No. 1 and 2 proves the presence of a mechanical obstruction in the middle ear. On the other hand, our ability to overcome this obstacle by blowing through catheters No. 3 and 4, and the moist mucous sound that is then produced, indicate the presence of a more or less abundant sero-mucous or purely mucous and tenacious secretion, in the cavity of the tympanum (free exudation), and also shows us that this obstacle is capable of easy removal ; and, further, the greater or less difficulty felt in propelling the blast of air enables us to judge with great accuracy of the nature and consistence of the exudation. If, now, after repeatedly and strongly blowing in air at one and the same sitting, the sound, which was at first moist and mucous, becomes at last clear, it follows that the

current of air, upon again streaming out, must have carried with it the free exudation contained in the middle ear; and the improvement of the deafness which immediately follows the passage of the air, and, finally, the removal of the moist mucous sound of the current, prove that the free exudation has been the cause of the deafness and of the noise in the ears, by interrupting the waves of sound passing from the membrana tympani through the air of the tympanic cavity to the membrane of the fenestra rotunda (p. 7 *et seq.*). But when the tone of the in-blown air is dull, and the current does not pass through the tube nor arrive at the membrana tympani, there is never any improvement of the hearing, and a proof is obtained that the free exudation only occasions deafness by its accumulation in the tympanic cavity, and very probably is wholly absent, or exists in but very small quantity, in the Eustachian tube.

If, after repeated insufflation at one or several sittings, the stream of air driven through No. 1 catheter arrives at the tympanic cavity, it proves that besides the free exudation, no interstitial exudation, is present.

There is a strong predisposition to the formation of free exudation in the middle ear amongst stout, scrofulous people. At the same time it is by no means uncommon in strong and healthy adults. Amongst the latter, however, cold must act more intensely, in order that the same number of cases may occur as in strongly predisposed individuals. The course of this disease is extremely tedious, and there is little prospect of spontaneous cure. The partial improvement which sometimes occurs independently of treatment probably depends on the flowing out of the free exudation contained in the tympanic cavity from the above-mentioned favorable circumstances.

In the majority of cases no spontaneous improvement of the deafness occurs; but after the earlier stages of the disease have lasted for a variable period, this symptom still remains well marked after many years, and even to extreme old age. In these cases the deafness is usually very complete. The free exudation undergoes no essential change, even when it is long retained in the middle ear; it is, at all events, a grave error to attribute to it an operation as of a mechanical body pressing upon the membrana tympani, and producing absorption or inflammation, or, still less, perforation. The advocates of this view (Toynbee, Erhard, &c.), in consequence of their predilection for Valsalva's experiment, have scarcely ever really ascertained the presence of free exudation in the tympanic cavity

antecedently to such perforations, whilst I have diagnosed many hundreds of such cases, in which the free exudation was subsequently removed by treatment, and had been of long standing, but in which there was no concomitant affection of the membrana tympani. Rau is the only surgeon who has made any exact observations on inflammatory perforation of the membrana tympani taking place from the tympanic cavity, that is, from within outwards, without having ascribed the inflammation to pressure of the free exudation accumulated in the tympanic cavity. Erhard's assertion that free exudation does not occur in that cavity, but only in the Eustachian tube, and that it is constantly accompanied by the dropping out of tough mucus on the wall of the pharynx, is sufficiently disproved, not only by the great rarity of this last phenomenon, but especially by the exact physical diagnosis already detailed, by which it is shown that the tubes in all probability contain little or none of this exudation.

The prognosis, on the whole, is very favorable, for free exudation can always be removed with certainty, and in recent cases and in strong constitutions the catarrhal inflammation of the middle ear either terminates in free exudation, and is therefore easily curable, or, where this does not occur, the disease can still be permanently and completely cured by perseverance in the use of appropriate local and general remedies. Recovery will be essentially aided by mild, warm, and dry weather, and by residence in an agreeable climate ; when the opposite atmospheric conditions prevail, the cure will be rendered proportionately more difficult. Special regard must be paid in the treatment to the condition of the mucous membranes in general, and to the activity of the digestive organs. If the patient have a tendency to abundant secretion of mucus, digests his food imperfectly, and has inactive bowels, we must exclude fat, starch, milk, and similar food, from his diet. Daily free evacuations must be obtained, and where there is an abundant secretion of mucus covering the throat and mucous membrane of the stomach, as occurs in some rare cases, we may prescribe a strong emetic at the commencement, and follow it up with astringent gargles, alum and sulphate of zinc. We should recommend the patient to wash the upper part of the body with fresh cold water and rub himself dry with coarse towels, but he should not take much physical exertion in dry, even if it be cold, air, and any scrofulous predisposition is to be combated by the usual well-known specific remedies.

These general remedial means are, however, very gradual in their effects, and in great measure insufficient for the cure of the disease; at all events, they should not be allowed to interfere even for a single day with the local treatment, which gives the most encouraging results, and, when the patient is otherwise healthy, will alone be sufficient to lead to perfect recovery. In order to remove the free exudation, air should be blown through catheter No. 3 or 4 with sufficient force, the pressure being gradually increased, to drive it through the Eustachian tube into the tympanic cavity, so that it may appear to pass through into our own ear. When this occurs, immediate and great improvement is experienced in the various local symptoms. Upon repeating it, the mucous character of the sound becomes gradually less distinct, and at length entirely disappears, and we have thus a limit fixed, beyond which it will not be advisable to go at any one time, lest by too frequently or too strongly blowing into the tympanic cavity we may excite mechanical irritation of its membrane, which is now freed from exudation, or may increase the catarrhal condition, which is already present. It is important, therefore, to remember, in the treatment of these diseases, that the force and size of the blast of air (dependent upon the diameter of the catheter) should merely be sufficient to allow the air to pass into the tympanic cavity. A large size of both is required at the commencement of the treatment and in cases when the mucus is particularly tenacious, but with the progress of cure and with the easier passage of the current we may diminish, not only the pressure, but also the volume of air, by using a smaller catheter, so that we must often commence with a No. 4 catheter, but must always conclude the treatment with a No. 1.

If the strength of our lungs be not sufficient to bear the fatigue of repeated acts of insufflation without injury to ourselves, the strong compression machine will prove of service which I have described in my 'Diseases of the Ear,' 1849, Tab. II, Fig. 8, p. 495, and will not here repeat, because it is only required for these exceptional cases.

If we now return from this digression to the termination of the first sitting, and to the resulting improvement of the hearing, freedom from noise in the ears, &c., it now becomes necessary to ascertain the distance from each ear at which a test watch can be regularly and distinctly heard. The period when the operation of insufflation should be repeated depends upon the duration of the improvement. If, after a few days, no further improvement occur, we

delay the next operation for two or three days, being persuaded that the excessive secretory activity of the inflamed membrane of the tympanic cavity will be best restored to its healthy condition by the exercise of moderation in repeating the operation. But if the improvement have partially or completely passed off within the first twenty-four hours after the operation, it should be immediately repeated, in order to remove the large quantity of free exudation which has reaccumulated, and to exercise a stronger mechanical irritation upon the membrane lining the tympanic cavity. If, after daily repetitions of the operation, the improvement become well-marked and more permanent, it should be repeated only after the intermission of one or two days, in order to avoid too great irritation of the tympanic membrane. By these simple proceedings, perfect recovery may in many instances be effected. If, on the other hand, continual relapses take place, and the increase obtained in the volume of the air entering at each operation be not sufficient, whilst the mucous character of the sound still remains very distinctly perceptible, we must assume that the free exudation is very tenacious. In such cases we take up a few drops of a warm solution of gum arabic in the beak of a No. 1 catheter, the funnel of which is stopped by a cork (as has just been described in the treatment of suppressed exudation), introduce the catheter into the tube, remove the cork, and quickly blow the drops into the tympanic cavity. The propulsion of the current of air is much less troublesome through catheters No. 3 and 4, and an excellent and permanent improvement generally follows their employment. The operation must then be repeated daily till the patient is well.

The same procedure is advisable if the improvement which may have already commenced be checked, or if the patient be actually thrown back by the supervention of nasal or bronchial catarrh. Lastly, if the mucous sound be completely removed, with great improvement in the hearing, but the moist tone of the entering current be replaced by a hard, dry tone, gradually producing great increase of the deafness, whilst the general health of the patient continues good, we may consider that we have to deal with over-excitement of the inflamed membrane of the tympanic cavity and suppressed exudation. That this is the result of too strongly and too frequently blowing in air is shown by its general occurrence after forcing in cold air by the compression machine. The treatment already described (p. 89) is then indicated, until the free exuda-

tion is again poured forth, always taking special care not to repeat the operation too frequently. By thus modifying our treatment according to the nature of the case, the free exudation usually, after a few repetitions of the operation, disappears, at least in recent cases and in strong individuals; but under unfavorable circumstances three or four weeks may be required, and sometimes as much as several months, before the air blown in through catheters No. 1 and 2 reaches the tympanic cavity easily and in full stream, and with the production of a clear, soft tone. The hardness of hearing is then permanently removed, whilst the noise in the ears has usually already vanished at an early period of the treatment. When we observe in bloated, unhealthy patients, or even in those who are otherwise healthy, abundant free exudation in the middle ear, which is constantly recurring, the membrane of the tympanic cavity requires the application of certain remedies in order to relieve this chronic catarrhal and inflammatory state. To effect this, air should be driven in daily through a No. 3 catheter, to clear out the free exudation; a few drops of a weak and slightly warmed solution of sulphate of zinc (gr. j ad iv, ad $\frac{3}{2}$ j aq.) should be blown into the tympanic cavity through No. 7 catheter, until the secretion returns to a healthy state, when there will be an immediate and permanent improvement in the hearing. In all these cases there is a strong tendency to relapse, and it is therefore advisable, even when the patient appears to be well, and especially in those cases where the excessive secretion has only just been subdued, to keep such convalescents under our eye for some time—where possible, for some months—so that if any slight recurrence of the deafness should occur, indicating fresh accumulations of free exudation, we may immediately remove it by blowing in a strong stream of air through a No. 3 catheter. In very obstinate cases we must once more employ the sulphate of zinc injection.

Catarrhal inflammation of the Middle Ear, with free and interstitial exudation.

This form of disease commences with hardness of hearing, which very gradually increases, until the patient ultimately becomes almost completely deaf. There is no local pain; both ears are usually attacked simultaneously, and the disease proceeds to the same extent in each. Noise in the ear is sometimes present, sometimes absent. The patients often complain of great fulness in the head and in the

ear, both when they are quite healthy, as is often the case, or are afflicted with other local or general disorders.

Ocular inspection of the external ear offers nothing characteristic. The ceruminous secretion is sometimes perfectly normal, sometimes deficient both in quantity and quality, friable, dry, or entirely absent. The membrana tympani is sometimes transparent and shining, but more frequently dull, white, and opaque. The manubrium of the malleus is scarcely or not at all cognizable. The examination of the middle ear yields much more satisfactory results. If we blow through No. 1 or 2 catheter into the Eustachian tube we can only hear a distant, dull sound in the ear of the patient, and even when the air is blown through No. 3 or 4 it generally passes with difficulty, and, perhaps, only by making the patient swallow at the same moment. It may be then heard to enter the tympanic cavity (and apparently also the ear of the observer), sometimes with full, sometimes with a thin and prolonged, stream, and moderately moist sound. The patient immediately experiences a very marked improvement in the power of hearing vocal sounds, though the hearing is not always correspondingly increased for inarticulate sounds, like the ticking of a watch. The duration of this improvement varies very considerably, but can always be renewed by repeating the operation of insufflation. The more moist the sound has been at the commencement of insufflation, and the more freely the air has entered the tympanic cavity at first, the more complete is the subsequent improvement, though, perhaps, the perfectly healthy condition is never regained.

In the majority of cases the difficulty which was first experienced in blowing the air through the Eustachian tube rapidly diminishes up to a certain point, and up to that point also the patients acknowledge that they experience a considerable improvement in the power of hearing. They are usually very well satisfied with this amount of relief, and declare that they are perfectly well. Noise in the ears, when present, is usually even still more completely relieved than the deafness.

If we inquire into the real cause of the difficulty in blowing air through the tube, we perceive immediately that it arises from a constriction in the tube (produced by interstitial deposit). On the introduction of catgut or elastic bougies not exceeding $\frac{1}{3}$ mm. in diameter into the Eustachian tube, we strike either in the first half, or certainly at the end of the cartilaginous portion, against an obstruction, which can only be surmounted by gentle pressure. This

occasions more or less acute stabbing pain to the patient, but upon passing it the bougie can be pressed onward without hindrance into the tympanic cavity, unless, indeed, it be stopped by another constriction. These obstructions are either broad and flat or circular and narrow, the latter being usually very tight, as we may assure ourselves by the effort required to push the bougie through them.

The velum palati and walls of the pharynx are usually dark red and swollen, with little or no mucus upon them. The amygdalæ are occasionally much enlarged, but never at any time form an obstacle to the entrance of the catheter into the tube.

Diagnosis.—The difficulty of propelling air into the cavity of the tympanum, even through catheters No. 3 or 4, indicates at once that there is some mechanical obstacle in the tube, which, from the difficulty (never, however, amounting to impossibility,) experienced in introducing sufficiently firm and very fine catguts or bougies, can readily be recognised as an organic constriction ; that is to say, a constriction formed by interstitial exudation in the tube. We may judge with sufficient exactness of its position, that is to say of its distance from the guttural and tympanic terminations of the tube by marking on the catgut or bougie the length of the catheter, and then from this point marking off towards the handle, one whole and two half inches. In adults the junction of the cartilaginous and osseous portions of the tube is about one inch from the pharyngeal opening ; about half an inch further, the osseous portion opens into the tympanic cavity, and if the bougie be pushed onward another half inch, it will traverse the diameter of the tympanic cavity ; unless on its entrance into this, its immediate withdrawal be not rendered necessary, (even when its diameter is only half a line) from the intolerable pain produced by touching the membrana tympani, or the still more distant malleus and incus.

It is by this interstitial exudation in the tube that the form of disease we are now considering is mainly distinguished from catarrhal inflammation of the middle ear accompanied by free exudation alone, of which we have already treated. The immediate improvement which takes place in the hearing, noise in the ears, &c., as soon as a current of air is driven through catheters No. 3 or 4, distinguishes this form of disease from the succeeding one, namely, catarrhal inflammation of the middle ear with interstitial exudation alone ; whilst this and the first-mentioned point of diagnosis render it impossible

to confound it with catarrhal inflammation accompanied by suppressed exudation. It is very difficult to determine the precise share which the free and interstitial exudation individually take in the production of the deafness. The more moist the sound of the air passing through the tube is, by so much the more important becomes the free exudation, and by so much the greater will be the improvement of hearing which follows its removal by insufflation; whilst in many cases and especially in young people, a perfectly normal sound of the current of air becomes perceptible, which is followed by extraordinary improvement in the hearing, but which after four-and-twenty hours, or even sooner, prematurely passes off. It is difficult to explain this circumstance otherwise than by supposing that the chief cause of the deafness is extensive interstitial exudation, interrupting the communication between the external air and that contained within the cavity of the tympanum, and that this is transitorily re-established by the operation of blowing in air. Perhaps the same explanation will apply to those cases where the patient is able to recover his hearing for a short period by driving air into the cavity of the tympanum with a forcible expiration whilst his mouth and nose are kept closed. It has been customary to attribute this transient improvement to increased tension of the membrana tympani, (which was supposed to be relaxed,) occasioned by the pressure of the air entering the cavity.

The chief cause of the disease is doubtless exposure to cold, though from the dilatory manner in which the disease progresses, it can seldom be accurately determined. Many patients are very healthy and strong, and it generally affects the male sex; occurring at all periods of life even up to sixty or seventy years. This form of disease constitutes 10 per cent. of all aural affections (108 : 1000. See Table, p. 17).

The progress of the case is always tedious, with a gradual but certain tendency to become worse, which is especially favoured by general catarrhal indisposition, and by typhous and gastric fevers. We can never calculate upon spontaneous recovery, and it is easy to err in this respect, for there are many patients in whom both ears are apparently equally deaf, though in point of fact the hearing of one only is deteriorated, and we might thus be easily led to consider that the ear which has really remained unaffected has improved.

The prognosis is very favorable as far as relates to the free exudation and the loss of the power of hearing which is either wholly or partially dependent upon it, but very doubtful as regards the

removal of the interstitial exudation, even if, as in the most favorable cases, it is limited to the Eustachian tube, and either does not affect at all, or but very slightly, the cavity of the tympanum. In proportion to the difficulty and pain experienced in introducing even the finest bougies through the tube; in proportion also to the duration of the complaint, and to the age and general health of the patient, will be the difficulty of procuring absorption of the interstitial exudation, and of restoring the canal to its normal dimensions. Fortunately, however, the patients feel in general such marked relief in regard to their hearing, the noise in the ears, and dulness and weight in the head, from the removal of the free exudation, that they willingly submit to further treatment for the interstitial exudation.

Care should always be taken to ascertain whether any constitutional affection is present, and, if so, the ordinary general treatment should be applied, though it must not be expected, even when the most favorable results are obtained, that any well-marked improvement will be observed in the free, and still less in the interstitial exudation in the middle ear. The most perfect cures of constitutional affections accomplished by the Carlsbad, Toplitz, Kreuznach, and other similar baths, effect as little improvement in the local disease, that is to say, in the aural affection, as Zittmann's decoction, or the use of iodine or mercury, pushed to its fullest extent. In all such cases local treatment applied to the middle ear is still absolutely required, and the only advantage we obtain is that our local remedies are no longer injuriously influenced by the presence of a constitutional disorder. When the patient however is healthy, and altogether free both from imaginary and real constitutional disease, we should not waste time, but proceed at once to the local treatment of the aural affection. If, however, the patient should be attacked by a violent catarrh, all treatment must be immediately discontinued, and it can only be advantageously resumed when the catarrhal symptoms have been subdued. The directions respecting the diet of the patient—as that it should be free from fat, and of a strongly nourishing character—having been already fully detailed in reference to the previous form of disease, and being equally applicable here, I need not repeat them.

In well-marked chronic catarrh of the mucous membrane of the gums and of the throat, the most serviceable remedies are astringent gargles, and the painting of these parts with solutions of nitrate of silver, alum, sulphate of zinc, and tincture of iodine. When

the disease is very obstinate, these means should on no account be neglected, and we must then endeavour to accomplish the removal of the free exudation. Air must be driven with gradually increasing pressure, with catheters No. 3 or 4, through the tube into the tympanic cavity, the patient swallowing at the moment, if any difficulty is experienced, for upon the passage of the air depends the removal of the free exudation and all subsequent improvement of the functional disorders of the ear. If the air can be made to pass by these means in the first instance, we must rest content, and not attempt by a too frequent repetition of the operation to excite the diseased and irritable membrana tympani. If, however, this has occurred, it is recognised by sensations of weight and fulness in the ears, and also by the circumstance that the improvement of the hearing, which was at first perceptible, does not continue to progress. But if by cautious treatment no such irritation has been produced, whilst the improvement of the hearing and the diminution in the noise of the ears are persistent, we may venture on the operation every day, still taking every precaution both as regards the increase in the size of the catheter, and the force of the blast, so that we may exercise no unnecessarily strong mechanical irritation upon the membrane lining the tympanic cavity. We may venture to hope that we have obtained a complete mastery over the free exudation, when no further improvement takes place in the hardness of hearing, and noise in the ears, whilst at the same time the moist sound of the inblown air is entirely lost, especially when No. 3 catheter is used. It is then time to commence the treatment of the interstitial exudation in the tube, in other words to effect its absorption ; when this is accomplished, even the thin and weak stream of air blown in through catheter No. 1, will enter the tympanic cavity with ease and freedom.

We can only expect to effect the absorption of the interstitial exudation by the local application of gently stimulating remedies, and then only in young persons who are in full health, and whose nutritive and interstitial changes are rapid and vigorous. In such cases we blow into the Eustachian tube from three to five drops of a weak solution of nitrate of silver (gr. i—iiij, ad $\frac{3}{2}$ j) through No. 1 catheter, whose beak, as well as the small tubular mouth-piece of the syringe, are constructed of platinum. The solution should penetrate as far as the stricture. The patients must not make any movement of swallowing, lest some of the fluid should be im-

pelled through the stricture into the cavity of the tympanum, which might produce a disagreeable sense of pressure and fulness. In general this proceeding can only be repeated every third day.

Thus in the course of some weeks or months we may be able gradually, without resorting to other means, to restore the permeability of the tube for a weak and thin stream of air. Should these means, however, prove inefficient, or should the duration of the disease, the age, and the constitution of the patient present no prospect of success from their employment, we must then endeavour, by means of properly applied pressure, to effect the absorption of the exudation. For this purpose, catgut and elastic conical (not Bonnafont's cylindrical) bougies are best adapted. Catgut is particularly convenient in those cases where the stricture will not permit the finest bougies ($\frac{6}{20}$ mm. in diameter) to pass, for the finest lute-strings have a diameter of only three twentieths of a millimetre, and others can be obtained of gradually increasing diameter. If, however, bougies can be passed through the stricture, they should certainly be preferred, on account of their conical form, and because also they can be repeatedly employed without being spoilt, whilst the catgut becomes so soft in the Eustachian tube, that they must be thoroughly dried before they can again be used. Moreover, the conically-shaped bougies exert greater and more even pressure upon the surface of the stricture than the catgut, although this also swells at the same time that it softens. Before introducing catgut into the tube, it should be lightly chewed for about $\frac{1}{2}$ mm. in extent—a proceeding which is unnecessary in the case of the bougie, on account of its uniform softness. On both instruments, the exact length of the catheter must be indicated (on the bougies with white oil-colour). Another mark should be made one inch from this point, and again two others at successive distances of half an inch, so that we may be able to determine the distance to which the instrument has penetrated into the Eustachian tube. It is not sufficient to have only Bonnafont's bougies of $\frac{1}{4}$, 1, and $1\frac{1}{2}$ mm. in diameter, for use. I employ those of $\frac{6}{20}$, $\frac{7}{20}$, $\frac{8}{20}$, $\frac{11}{20}$, ($\frac{1}{2}$ mm.) $\frac{13}{20}$, $\frac{15}{20}$, $\frac{16}{20}$, = 1 mm. and $1\frac{1}{2}$ mm. in diameter, so that in very tight strictures the size of the instrument may be very gradually increased, without occasioning pain to the patient. As a general rule, it is advisable only to employ the means of dilatation of such magnitude that they require a moderate amount of pressure and produce but slight pain to pass through the stricture, and the

size of the instrument should only be increased, when the smaller one previously used passes with facility.

Bonaffont proposes to force a passage through strictures which have their seat immediately in front of the osseous portion of the Eustachian tube, with strong elastic bougies, which might tear up the mucous membrane. From a theoretical point of view, this may, perhaps, be readily accomplished, but it will be found practically, that even with every care it is impossible to succeed in its execution. Bonaffont not only extols this operation highly, but also the application of caustic, as of nitrate of silver in powder to the stricture, which he applies by means of a small hollow, silver, "Porte caustique," 2 mm. in length, and about 1 mm. in diameter, attached to the end of an elastic bougie introduced through a catheter; but such an operation, on account of the great tenderness and narrowness of the part, must demand great care and skill.

Let us return from this digression to the treatment of interstitial exudation in the tube. In the first place, an endeavour should be made to ascertain what sized catgut or bougie can be pushed along the tube (as far as the entrance into the tympanic cavity) by moderate pressure, and without giving very severe pain to the patient. It should remain in this position for about a quarter of an hour, to which end the catheter can be fixed by my forehead band. This consists of a metallic plate, about the size of a dollar (easily capable of being moulded to the form of the forehead) which can be attached by two lateral straps buckling at the back of the head. On the middle of the plate is a ball and socket-joint, in which a little circular pair of forceps moves. These can be fixed by a side screw, when the arms of the forceps have embraced the catheter, and this again is retained in a convenient position in the nostril, by means of a small screw passing through one or both arms of the forceps. The patient is thus enabled to make any movement of the head, to speak, to swallow, and the like, without in the least altering the position of the instrument. In order to spare the patient pain, the catgut or bougie should only be passed as far as the entrance into the cavity of the tympanum, contact with the membrana tympani or ossicula being avoided, and this can only be done when the distances are marked upon the instrument in the manner we have described. When the catgut or bougie has remained long enough in the Eustachian tube, it should either be replaced with one of larger diameter or simply

withdrawn, and the operation be completed. The instrument should then be carefully dried with soft, clean, linen rag, and a few drops of the above-mentioned solution of nitrate of silver blown into the tube against the stricture, through a No. 1 catheter, which may be done twice a week with advantage, whilst on the other hand, the catgut or bougie may, in the majority of cases, be cautiously introduced every day. Months may elapse, even in favorable cases, before absorption of the interstitial exudation can be effected to such an extent that a bougie of 1 mm. in diameter can be readily introduced without producing severe pain, as far as the cavity of the tympanum, and before a current of air will pass with facility into the cavity through a No. 1 catheter.

But unfortunately we are not able in many cases to accomplish this, partly on account of the firm organization of the interstitial exudation, and partly from the want of time and patience on the part of the patient. In such cases, in which the improvement in the hearing and of the noise in the ears resulting from a strong blast of air blown through the tube into the tympanic cavity, endures only a few days or weeks, nothing remains to be done but perforation of the membrana tympani, which restores the communication of the air with the tympanic cavity, hitherto interrupted by the interstitial exudation of the tube. The membrana tympani is not thickened in all these cases, though it usually is so when chronic inflammation has been removed, and some deafness remains. It is, therefore, in general readily perforated, but unfortunately this easily accomplished, and frequently practised operation invariably fails, because we are unable to keep open the hole in the membrane, so that we must protest, even in these cases, against what would otherwise be a perfectly justifiable operation.

Catarrhal Inflammation of the Middle Ear, with exclusively Interstitial Exudation.

The commencement of this disease is usually first observed on some occasion when the hearing is put to some particularly severe test. It is then apparent, both to the patient himself and to his friends, that there is a marked defect in the power of hearing in one or both ears. Usually, little or no disquietude is felt on the discovery of this circumstance, either because one ear only is affected, or because the power of hearing with the two ears is still sufficiently serviceable for ordinary intercourse. The patient continues to endure, with infinite patience, many inconveniences as the deafness increases, in the vain hope that,

his health being in other respects good, so insignificant an affection will soon disappear. As years roll on, however, and the deafness still increases, he is unable any longer to conceal the fact of its existence. He feels, also, that noises in the ears are becoming troublesome, and in many instances he observes, after some febrile ailment (catarrhal, gastric, intermittent, typhus fever), that the deafness has rapidly increased in severity. The occurrence of this may often be considered rather fortunate than otherwise, since it leads him to subject himself to appropriate treatment. On the other hand, it often happens that the patients, whilst travelling over paved streets, or on the railway, or during a temporary stay in mills, factories, or in the immediate vicinity of a large orchestra, experience so great an improvement in their hearing for vocal sounds, that they are much inclined to consider their aural disease as not demanding assistance, and carelessly to allow it to acquire its fullest development, when it becomes perfectly incurable.

In this way numerous cases of hardness of hearing, approximating to complete deafness, occur, without the patients experiencing any mental disquietude in respect to the grave nature and incurability of their disease.

The secretion of cerumen remarkably diminishes, the meatus becomes dry, there is great and very troublesome itching, small, dry, and dark-brown scales form, or bran-like, or even fish-scale-like desquamation occurs, the scales being white and shining. In like manner very often the secretion of the pituitary mucous membrane diminishes, so that the patient seldom has occasion to use his handkerchief. The appearance of the membrana tympani is generally, though not indeed always, dull, opaque, white, like paper, with the manubrium of the malleus showing less distinctly in proportion as the concavity of the membrane is diminished by increased interstitial exudation.

The velum palati, uvula, and walls of the pharynx are usually abnormally red, and the amygdalæ are occasionally considerably swollen, though their surface is never covered with mucus. If we direct the patient to make the experiment of Valsalva, whilst we listen either with the otoscope, or with our own ear applied to that of the patient, we hear, or may think we hear, a crackling sound in his ear. If, not content with this, we blow air into the Eustachian tube, either by means of a machine, or through a catheter of medium size, and feel or hear the air press through into the tympanic cavity, we may

in all these cases, no doubt, make the diagnosis of free passage of the current, and may suppose that there is no organic disease in the middle ear, or, in other words, we may diagnose the presence of nervous hardness of hearing and deafness.

But if my variously sized catheters be employed for the operation we obtain quite different results. The air never reaches the tympanic cavity through No. 1 and 2 catheters, but only through No. 3, or in well-marked cases through No. 4, and not even then unless the patient at the same time makes a movement of swallowing. The stream passes generally only by fits and starts, but even if it be continuous though fine, the sound produced is dull, non-resonant, and dry, and there is not only no improvement in the hearing, but if the operation be performed too frequently, or the pressure employed be too great, there is an actual increase in the deafness, whilst noises in the ear, which may not have hitherto been perceived, are induced.

Upon the introduction of catgut and other bougies, even of the smallest diameter ($\frac{4}{5}$ mm.) into the Eustachian tube, they are invariably found to strike against one or several consecutive constrictions, which may vary considerably in extent. These can only be overcome by exerting more or less pressure, so as to force the instrument through into the tympanic cavity, a proceeding which is always accompanied with most acute, stabbing pain, continuing till it reaches the middle of the cavity. It follows from this, that in these cases the tube is by no means free, but, on the contrary, is considerably narrowed by interstitial exudation. In like manner the cavity of the tympanum is greatly diminished in capacity, from the same cause, and is not only wholly destitute of all free exudation, but is not even covered by its normal sparing exudation; as is indicated by the dull, dry, non-resonant tone, produced by the current of air.

Interstitial exudation of the tympanic cavity affects apparently the (opaque, white, but slightly concave or even plain) membrana tympani, and also in all probability the membrane of the fenestra rotunda. These changes furnish a sufficient explanation of the hardness of hearing, though the interstitial exudation in the Eustachian tube appears to be an important element in its production, by interrupting the communication between the tympanic cavity and the external air.

The difficulty with which the air penetrates the tympanic cavity

when blown through a No. 3 catheter, enables us to diagnose this affection very easily from catarrhal inflammation of the middle ear with suppressed exudation, whilst cases of free exudation are sharply defined by the moist tone of the stream of air blown in, and by the immediate and remarkable improvement which then takes place in the hearing and noise in the ears.

Catarrhal inflammation of the middle ear with interstitial exudation of the Eustachian tube, and of the cavity of the tympanum, is the most common of any of the diseases of the ear, occurring in the proportion of 407 : 1000, and constituting, therefore, more than 40 per cent. In disproof of this statement, the rarity with which it has been observed on dissection by Toynbee has been adduced by Erhard, but on insufficient grounds, since it appears that Toynbee chiefly dissected ears that had been cut out of the dead subject, and had been sent to him without the tube, so that he himself says that, "judging from practical experience, there can be little doubt that this appendage of the hearing apparatus is more often affected than the morbid conditions, detailed in this volume, would seem to indicate." (*Vide 'Descriptive Catalogue,' p. 8.*)

This explanation, however, would scarcely lead us to expect so great a proportion of these cases of disease as that above mentioned, especially since we are only able to recognise them during life, with any degree of certainty, by physical investigation of the middle ear, with the catheter and catgut bougies. We are unable to determine what specially occasions or predisposes to this exclusively interstitial exudation of the middle ear, which is so common, unless we are contented to acknowledge the usual causes of disease in general, cold, scrofula, &c. It is certain that this disease occurs at every period of life, and with nearly the same frequency, and with equal obstinacy both in the healthy and the unhealthy.

During a residence of several months in London, in 1861, I observed this form of disease very frequently; indeed, out of about 200 cases occurring in the middle and higher classes of society, there were about 72 per cent. of this disease, whilst of free and interstitial exudation there were only 9 per cent., and of free exudation alone only 5 per cent. The causes of the frequency of this unfavorable form of disease of the middle ear in England, I attribute to the common custom of washing the head and ears every morning with cold water; to the general employment of sea bathing without stopping the ears with sheep's wool, to the practice of keeping open one window at

least in the sitting and bed-rooms, in the latter even at night, whilst a constant draught of air is kept up by the open chimney and fire-place, which is greatly increased by the doors being left open, and lastly to the injurious effects of the strong meat diet of the English, which causes a deficient secretion of mucus (*i. e.* free exudation) from all mucous membranes.

The progress of this affection is extremely slow. It is often protracted through many years, or even through life, the symptoms continually increasing in severity. There is little tendency to improvement, and spontaneous recovery perhaps never takes place; but on the other hand, in various constitutional affections, especially of a febrile character, sudden increase in the hardness of hearing and noise in the ears occur either as accompaniments or as consequences; the latter not unfrequently gradually disappearing as recovery takes place, whilst the former remains, and increases in severity. The prognosis is exceedingly unfavorable, and the more so in proportion to the small size of the catgut bougie required to penetrate the constriction in the Eustachian tube, and in proportion also to the acuteness of the pain experienced in passing it, to the annular form and tightness of the stricture, to the dulness and want of resonance in the sound of the entering stream of air, and to the deterioration in the hearing, and increase of noise in the ears, consequent upon the operation. The concomitance of the scrofulous diathesis, with advanced age and long duration of the disease, is of bad augury for the resorption of the interstitial exudation, especially of that thrown out in the tympanic cavity. On the contrary, the occurrence of the affection in the course of severe catarrhal, gastric, typhus, and other fevers, with deafness either then first produced, or greatly increased if previously of long standing, permits us to entertain good hope of spontaneous recovery; providing great attention be paid to the ear during convalescence from the primary disease; after this period has passed, however, we cannot expect much assistance from nature.

In the treatment, attention should be paid in the first instance to any constitutional affection that may be present, whether in the blood, in the nervous system, or in the functions of the abdominal viscera, even if we are unable to show any genetic relations, between them and the aural disease. By attention to these, we may at least reasonably expect to produce considerable improvement if we do not effect a perfect cure. At any rate we shall then feel that we have neutralized as far as possible the injurious effects of such general

conditions of disease upon the organ of hearing. Perfect restoration to health, the chief problem with which we have to deal, now depends upon local remedial means ; the application of which, in otherwise healthy people, should now be immediately commenced. It is seldom necessary in these cases to give any specific directions in regard to diet. The slight catarrhal affection of the pharynx and velum palati usually present, only demands the patient and persevering application of astringent gargles, or lotions of zinc and nitrate of silver.

In the treatment of diseases affecting the middle ear, we should take care not to blow too frequently or too strongly into the cavity of the tympanum, lest we produce sensations of pressure and fulness, with increased deafness and noise in the ear. We can easily ascertain whether any changes are taking place in the interstitial exudation by introducing bougies or catgut, or by blowing in air through No. 1 or 2 catheter. The next difficulty to be overcome is the re-establishment of the passage through the tube by the absorption of the interstitial exudation. A few drops of a solution of nitrate of silver (gr. iii, ad $\frac{3}{4}$ j) may be employed for this purpose in young subjects, or in cases where the disease has been of short duration. It should be applied in the manner I have so frequently described, when speaking of other diseases of the middle ear, by means of catheter No. 1, whose beak is constructed of platinum, and the funnel-shaped end closed with a cork. The application of the solution should be repeated every third day. The immediate effect of this operation is generally so irritating that there is an increase in the spongy swelling of the mucous membrane, and a temporary increase in the difficulty of blowing air into the tympanic cavity. After a few days have elapsed, however, this diminishes, and after the application of the solution has been properly repeated, slowly progressing absorption of the interstitial exudation takes place, so that after some months of persevering attention, air can be blown with facility into the tympanic cavity through catheters No. 1 or 2. I have never found stronger solutions of nitrate of silver to act beneficially. In many cases the excitability of the mucous membrane of the tube is so great, that I am accustomed to diminish the dose of nitrate of silver to gr. j, ad $\frac{3}{4}$ j aq., or to exchange it for a solution of sulphate of zinc (gr. v, ad $\frac{3}{4}$ j aq.). In the propulsion of these fluid remedies, the patient should be directed not to make the movement of swallowing, lest the drops should, if the stricture be only moderately tight, be driven into the tympanic cavity, producing

pressure, fulness, and dulness of hearing. If we cannot restore the passage of the Eustachian tube by these means, we must have recourse to catgut and conical bougies, especially in very old and well-marked cases, with firmly organized interstitial exudation ; more particularly in old people. In such cases, these instruments must be employed from the commencement.

It may be stated as a fact of general application and of considerable importance, that no violent stimulation applied to the strictures, either by nitrate of silver or by mechanical pressure, will produce re-absorption of the interstitial exudation, but will, on the contrary, rather tend to increase it ; and this in proportion to the pain produced, and to the pressure exerted by the catgut or bougie. Such an instrument should therefore be employed, as requires the application of but a moderate degree of force to pass it through the stricture, and does not give much pain to the patient. It is often necessary to begin with an instrument of $\frac{4}{10}$ mm. in diameter. This size can only be obtained in catgut ; elastic bougies never being made so small, because even when only $\frac{6}{20}$ mm. in diameter, they are far too pliable to permit sufficient force to be used to force them through close strictures. In these cases, therefore, the treatment must in general be commenced with catgut, and the bougies may be employed at a subsequent period. Bonnafont recommends bougies of at least $\frac{1}{4}$ mm. ($\frac{10}{20}$) in diameter, which he forces through with considerable pressure, and disregards the "déchirure du rétrécissement" thus produced. He smears the bougie with a caustic salve, and even arms its apex, as we have already mentioned, with a "porte caustique," of nitrate of silver. These measures, however, have not in my hands been productive of any good results. Bonnafont's "filiform bougies" are moreover cylindrical, and are therefore not so well adapted as my conical ones for the forcible dilatation of the strictures. Yet I have never found much benefit result from using great force ; whilst the application of irritating salves of red precipitate, and of iodine, or of solutions of nitrate of silver, iodine, &c., even when very weak, have always proved positively injurious, though I have frequently employed them with the aid of catgut and elastic bougies. Bonnafont assures us that by means of his "bougies filiformes" he is able "de triompher de tous les obstacles qu'on peut rencontrer dans le Trompe," a statement we would willingly admit if it were not in such direct antagonism to the results of our experience. It is impossible to regard strictures of the Eustachian tube in the same light, as regards

treatment, with strictures of the urethra, for the latter is everywhere surrounded by soft parts; whilst the former in its narrowest part consists of an inelastic bony canal, whose point of union with the cartilaginous portion is usually the chief seat of the interstitial exudation.

The dilating instrument therefore will press the thickened mucous membrane of the Eustachian tube against the unyielding bony walls at this point, producing a greater or less amount of irritation, increased interstitial exudation, and very decided increase in the difficulty of passing any instrument. We here, therefore, see the great advantage of using instruments which gradually increase in size, and the necessity of patience in their employment; and we must learn, from their effects in each individual case, whether they should be introduced daily or more rarely, and whether they should be allowed to remain a few minutes only, or an hour. As a matter of convenience, I am accustomed to apply my frontal band (see above, p. 104) round the head, and after the introduction of No. 3 catheter (or on using bougies of 1 mm. in diameter, No. 4 catheter) into the tube to fix it firmly between the arms of the frontal band in the nasal cavity. The bougie, its point lubricated with a little oil, may then be introduced as far as the entrance into the tympanic cavity, but not beyond that point, lest the membrana tympani may be unnecessarily irritated. We may thus spare the patient from suffering acute pain, and the operation is easily accomplished, because the length of the catheter and of the Eustachian tube are indicated upon the catgut or bougie, and it is only necessary to adapt with care the size of the bougie to that of the constriction which it has to pass. After a short time, the bougie must first be withdrawn, and then the catheter; unless we are disposed to apply to the constriction a few drops of a weak solution of nitrate of silver or sulphate of zinc, or of hydrochlorate of ammonia, through No. 1 catheter. If by the employment of these troublesome remedial means we are successful after the expiration of some months in re-establishing the normal diameter of the tube, the insufflation of a few drops of one of the above-mentioned very dilute solutions into the tympanic cavity, constitutes the best means for the removal of the still remaining interstitial exudation; coincidently with the gradual absorption of this, the hearing improves, the noise in the ears diminishes, and in favorable cases may even altogether disappear, and the patient may be dismissed, cured.

Noise in the Ears without Hardness of Hearing.

This disease almost always affects both ears equally, and either suddenly or gradually rises to a great degree of intensity. It may last for months, or even for life. It rarely affects one ear only. The sounds vary much in character. The faculty of hearing for either articulate or inarticulate sounds, does not seem to be impaired. The meatus and membrana tympani are normal. The Eustachian tube and tympanic cavity are pervious to the weak stream of air which can be blown in through a No. 1 catheter, which produces a clear, soft tone. If the air be driven in with great force through a No. 3 catheter (producing direct irritation of the chorda tympani), an increase in the noise is an immediate result. The seat of the noises perceived can only be in the chorda tympani, since the healthy condition of the external and middle ear can readily be shown by a physical examination, whilst the perfect power of hearing possessed by the patient indicates clearly enough the absence of any disease of the auditory nerve. Strong insufflation against the membrana tympani and the chorda causes an increase of the noise, and this can only be explained as a consequence of their abnormal irritability, though we may perhaps suspect that it has its origin in some organic change.

The diagnosis of this disease depends upon the results obtained by instrumental investigation in respect to the state of the external and middle ear, and upon the existence of a healthy faculty of hearing in the affected ear or ears. It is a rare affection, occurring only after violent cold applied to the head, or to the ear itself, such as cold winds, water, &c.

The prognosis is not unfavorable, since the passage to the tympanic cavity and to the chorda tympani is quite free. Local treatment will alone effect a cure, and a few drops of a solution of nitrate of strychnia (gr. i, in ʒj of water) will be found of great value, when injected into the cavity of the tympanum through a No. 1 catheter. This may either be repeated daily, or once or twice a week, according to the activity of absorption possessed by the membrane of the tympanic cavity.

Constitutional remedies, and counter-irritants, whether applied in the immediate vicinity of the ear, or elsewhere, are perfectly valueless.

Nervous Pain in the Ear (Otalgia).

Coincidently with acute pain in a molar tooth of either the upper or lower jaw, there occurs very violent and indeed almost intolerable pain in the ear of that side. The pain is deep seated and extends to the vertex, throat, neck, and even to the upper arm. It is generally continuous, but sometimes presents an intermittent character, unaccompanied by fever, and without serious disturbance of the general health beyond what is produced by the sleep being much broken. I have never observed noise in the ears or hardness of hearing to accompany it, but have always found the meatus, membrana tympani, and the middle ear, upon careful instrumental investigation, perfectly sound, and entirely free from all inflammatory symptoms.

In some bad cases the pain continues for weeks and months, long after the original pain in the tooth has been forgotten. In such instances little effect seems to be produced on its character and progress, when the patient is attacked by other febrile affections, as pneumonia, gastric fever, &c. The whole succession of the symptoms, together with the dentalgia from carious teeth on that side, and the absence of all inflammatory appearances in the affected ear, show clearly enough the secondarily nervous character of this pain in the ear. Its seat is doubtless in the ramifications of the fifth pair of nerves in the tympanic cavity, which painfully sympathises with the irritation of a few fibres of the alveolar branches of the same nerve distributed to a carious molar.

The curative treatment of this oftentimes intolerably painful affection depends entirely upon the removal, at as early a period as possible, of the originally aching or still painful molar tooth: immediately after the operation the pain in the ear vanishes completely and for ever.

The description which we have now given of the diseases of the middle ear does not, indeed, include those of the cells of the mastoid process, but these are never affected independently, nor are they recognisable or accessible to treatment, except when coincident with chronic inflammation of the perforated membrana tympani, or of the membrane or periosteum of the tympanic cavity. In the sections devoted to these affections we have already discussed the complications of the mastoid cells, and to these, therefore, it will be quite sufficient to refer.

CHAPTER III.—DISEASES OF THE INTERNAL EAR.

STRICTLY speaking, the consideration of the diseases of the internal ear should be limited to those of the osseous and membranous labyrinth; but these parts are in such close anatomical and physiological relation with the central extremities of the auditory nerves, that we may fairly include under this heading the various diseased conditions of those nerves; and we shall also here describe acute inflammation of the facial nerve, so far as it is contained within the petrous portion of the temporal bone, and affects sympathetically the auditory nerve; deaf-mutism, which must generally though by no means exclusively be attributed either to congenital or acquired disease of the internal ear, may also properly be considered in this chapter.

The deeply seated and concealed position of the internal ear, whilst constituting an effectual protection against external injury of all kinds, adds materially to the difficulty, and in fact renders it perfectly impossible to form a diagnosis of its diseases, from symptoms which are perceptible to the eye or the touch of the surgeon. The only exception that can be made is in the case of destructive inflammatory disease, such as caries of the temporal bone, resulting from chronic inflammation with perforation of the membrana tympani.

With the difficulty which is experienced in making an accurate diagnosis in these forms of diseases, there is, of course, a concurrent difficulty in determining the nature of the remedies which shall be employed. We can say, therefore, but little upon the treatment of cases, the exact nature of which is not always ascertained even on dissection: for treatment should always rest upon positive and not upon hypothetical curative indications.

Acute Inflammation of the Labyrinth.

This disease sometimes commences with extremely violent and deeply seated pain in the ear, acute febrile symptoms, loss of consciousness and convulsions; but sometimes with only moderate pain, extending from the ear over the squamous portion of the temporal bone and the corresponding half of the head, slight fever,

inability to hold the head up, coma, vomiting, and other serious symptoms. Within twenty-four hours after the commencement of the attack a sero-purulent discharge, which it is impossible to relieve or check, begins to take place from the affected, but previously perfectly healthy ear ; and in the course of a few days in the acute form of the disease, or in the course of a few weeks in the more chronic form, death terminates the sufferings of the patient with the well-known symptoms of general inflammation of the brain.

In both forms of the disease, dissection discovers serious lesions, such as destruction of the membrana tympani, of the ossicula, and of the osseous labyrinth, sero-purulent effusion in the middle and internal ear and into the cranial cavity, induration of the cortical substance of both the brain and cerebellum on the affected side, &c.—lesions which place the acutely inflammatory nature of the disease beyond a doubt.

The same series of symptoms constantly arises when the membrana tympani and labyrinth have been injured by sharp-pointed instruments, as, for example, by the incautious introduction of a knitting-needle, with which some persons clean out the ear, or by violent and awkward attempts to remove foreign bodies from the ear in spite of the struggles of the patient, by means of hooks, forceps, levers, and other similar instruments.

An accurate diagnosis can always be made in such cases by ascertaining what has occasioned the pain, and by examining the meatus by the direct light of the sun, when the destruction of the membrana tympani, and the effusion either of blood or of a sero-sanguinolent fluid into the cavity of the tympanum is rendered very apparent.

The prognosis is in the highest degree unfavorable when the cerebral symptoms are very severe and there is deep coma ; and even with less violent inflammatory symptoms the danger to life is very great.

In all cases the treatment must be energetically antiphlogistic. The head must be kept cool and elevated, and the patient as quiet as possible ; cooling drinks may be given with antiphlogistic purgatives ; free local and frequently repeated bleedings must be adopted from the ear and nape of the neck ; ice must be applied to the occiput, luke-warm oil repeatedly poured into the ear, and when the pain is very obstinate the ear must, in addition, be covered day and night with warm poultices of linseed-meal. By these means, we may perhaps subdue the inflammation in the ear and in the dura mater

and the violence of the pain ; and the life of the patient will be preserved, but the hearing of the affected ear is always irrecoverably lost.

Chronic Inflammation of the Labyrinth.

In this affection, after an apparently harmless discharge, varying in quantity and quality, has existed for some years from one or both ears, accompanied by more or less intense pain, the patient suddenly complains of dull pain in one ear, which spreads with greater or less rapidity to the temple and vertex, or to the occiput and neck. The discharge sometimes remains unchanged and is sometimes diminished. Occasionally, though more rarely, the pain in the ear is lancinating and extraordinarily severe, radiating as it were into the back, into the tongue, and into the soft parts of the neck and upper arm, which has very naturally led some to confound it with "Tic douloureux." In these cases the meatus contains, either in its deeper portion or more externally, an extremely sensitive fleshy outgrowth, which renders any examination with the aural speculum and blunt probe very difficult, or may altogether preclude their employment. In all cases the pain becomes perfectly insufferable on walking or driving on paved roads, on succussion of the head with the hand, or any other movement which produces vibration. The aspect of the patient becomes dull and apathetic, and he is greatly depressed. Wakefulness or comatose symptoms supervene, with inability to keep the head erect. Paralysis of the muscles of the face, and indeed of those of the upper arm of the affected side may occur, and sooner or later ill-defined febrile symptoms set in, the patient experiences rigors either of a typical or non-typical character, recurring several times a day, to which hot and sweating fits sometimes succeed. This condition may pass into typhus fever, accompanied by coma, delirium, fainting, and vomiting, leading to a fatal issue, when the sick man finds a happy release from his suffering. For some time before death the discharge acquires irritating properties, and becomes very fetid ; and when this occurs, the patient who was previously only hard of hearing now becomes perfectly deaf.

If an ocular examination can be made by the direct light of the sun, we can sometimes discern the above-mentioned fleshy outgrowth in the meatus ; or far more frequently, the membrana tympani appears either in great part or wholly destroyed : none of the ossicula can be

perceived, the tympanic cavity is filled with dirty pus ; its lining membrane is dark-red, swollen or partially ulcerated, and the rough surface of the carious bone is easily recognised on introducing a blunt silver probe. After death, besides the caries of the labyrinth just described, we find that the Fallopian tube is often also carious, the dura mater attached to the temporal bone discoloured, detached, thickened and covered with pus ; and the brain or cerebellum, especially the latter, affected in the most various ways by the inflammatory process, indurated or hyperæmic, softened or perforated by abscesses, which may communicate by means of carious openings in the temporal bone, with the labyrinth and the exposed tympanic cavity.

These disorganizations are so remarkable, and the original pain in the ears proceeding from chronic inflammation of the membrana tympani, is, on account of its long duration and the neglect with which it has been treated, so completely thrown into the shade, that various authors (Abercrombie, Itard, 'Otorrhœa Cerebralis Primaria'), founding their opinion upon the results of dissection, have sought to attribute to this dangerous and thoroughly secondary disease a primary character.

In some very rare cases the inflammation of the periosteum of the temporal bone does not spread to the dura mater and brain, but terminates in the exfoliation of portions of the carious bone. A most remarkable case of this kind came under my care in a boy seven years old, from whose left ear, which had been for several years discharging pus, I removed a piece of carious bone 1" long and $\frac{1}{2}$ " thick. This piece contained the meatus auditorius internus to the extent of $\frac{2}{3}$ ", a portion of the diploe of the temporal bone, and both fenestræ. A second smaller piece was subsequently removed ; and in the course of a month the ulcer in the external meatus had healed up, and the boy was allowed to leave the hospital without any other circumstance occurring worthy of note, except, indeed, that he was perfectly deaf on that side, and had paralysis of that half of the face.

The diagnosis of the chronic from the acute form of inflammation of the labyrinth depends chiefly upon the slow and gradual development of the former from an inflammatory condition which has long been present in the perforated membrana tympani and in the periosteum of the tympanic cavity. We can but seldom trace the causes (as exposure to cold) which have led to the extension of the

previously chronic inflammation of the membrana tympani to the periosteum of the tympanic cavity and to the labyrinth. We cannot, at all events, consider the diminution of the discharge from the ear as the cause of this extension, for it has only been occasionally observed ; it is rather the result, as are also the dangerous head symptoms, of the sudden and violent inflammation of the lining membrane of the tympanic cavity.

The prognosis is very unfavorable, especially in those cases where polypi and extremely sensitive outgrowths are developed either from the meatus or from the surface of the tympanic membrane ; and still more unfavorable where frequently recurring rigors occur, whether of the typical or non-typical character, for these may, with great certainty, be considered to indicate the occurrence of fatal suppuration in the cavity of the cranium.

That form of caries which is perceptible to the touch and is apparently merely superficial in the tympanic cavity is by no means so likely to terminate fatally, and the paralysis of the facial muscles on the same side is sometimes curable. But though in some cases we may, by good fortune, save the life of our patient, the faculty of hearing is, in all instances, irrevocably lost in the affected ear.

As regards the treatment, it should be commenced at as early a period as possible, and should consist in active local antiphlogistic means. The head should be elevated upon cushions stuffed with horsehair, and the patient should be kept in a cool room ; his bowels should be thoroughly opened by calomel and other purgatives, and as many leeches should be applied around the ear and on the occiput as his strength will permit. Ice should be applied to the back of the head, and lukewarm oil poured into the ear, especially if there be a cessation of the usual purulent discharge ; lastly, some powerfully counter-irritant ointment should be rubbed into the nape of the neck, till an abundant crop of pustules is produced. Circumstances must guide the practitioner as to the length of time the suppuration should be maintained. The existence of painful outgrowths seated in the meatus or in the periosteum of the tympanic cavity renders the application of every kind of caustic, of ligatures, cutting instruments, or even of weak solutions of zinc or lead, perfectly inadmissible, since all these produce more or less violent irritation of the tumour, and infallibly cause its increase or return. In all such cases I have seen death occur without a hope for the recovery of the patient.

Acute Inflammation of the Facial Nerve within the Fallopian Canal.

At the commencement of this disease a sudden, violent, and dragging pain is experienced in the cheek and ear of one side, which is greatly increased on making pressure over the point of issue of the nerve at the stylo-mastoid foramen. The pain is accompanied by paralysis of the facial muscles of the same side. Subacute febrile symptoms are present even on the first day ; hardness of hearing and noise in the ears are subsequently perceived. If the affection be not subdued, pain in the head supervenes, followed by delirium or coma, by rigors, alternating with hot fits, and lastly by stupor, terminating in death. In favorable cases an abscess forms below the mastoid process, the opening of which reacts favorably on the progress of the disease, and materially aids in removing the pain in the ears and cheek, the paralysis, the febrile symptoms, and the hardness of hearing and noise in the ears, and renders the recovery of the patient certain. When death occurs, the facial nerve is found on dissection, in its whole course from the stylo-mastoid foramen forwards, soft, swollen, and spongy, and the auditory nerve so soft as to be almost fluid. Pus is also found in the labyrinth and on the trunk of the seventh pair of nerves ; a large quantity of serum between the membranes of the brain, and softening of the cerebral substance. The membrana tympani and the meatus, on the other hand, are perfectly healthy. This last point furnishes a well-defined diagnostic mark between the disease we are now considering and the acute and chronic forms of inflammation of the labyrinth, both of which are frequently accompanied by paralysis of the facial muscles of one side. In like manner the paralysis of the muscles of the face enables us to distinguish between inflammation of the facial nerve and nervous deafness—otalgia nervosa (see next section).

“Exaltation of the faculty of hearing” has been described as a highly characteristic symptom of inflammation of the facial nerve, and it has been suggested that such “exaltation” results from paralysis of the tensor tympani muscle (Landouzy, Longet). But if we reflect that in those cases of disease which have been adduced in proof of this statement the inflammation had only been of short duration, and had never been very severe, whilst the subsequent paralysis of the facial nerve was of long continuance ; if we reflect, moreover, that the “exaltation of hearing” was not always present,

and when present was only of short duration ; and lastly, when we consider that this exaltation of hearing is observed in very various diseases of the ear, unaccompanied by paralysis of the facial nerve, we cannot but arrive at the conclusion that the above-mentioned theory is entirely unsupported by facts.

Acute inflammation of the facial nerve is a very rare lesion, and is only occasioned by exposure to severe cold, as, for example, washing the face with cold water whilst covered with perspiration, cold draughts of air against the side of the head when heated, and the like.

The prognosis must be given with some degree of caution ; for if the disease be neglected, either by the patient himself or by the surgeon, it may very easily prove fatal, by extension of the inflammation to the brain and its membranes.

In the treatment, active antiphlogistic means must be employed. The necessity for venesection must be determined by a review of the general symptoms, and especially of the state of the brain. If this be not implicated, a considerable number of leeches should be applied over the stylo-mastoid foramen, and these may be repeated, if required, whilst mercurial ointment should be rubbed into the adjoining parts. If painful swelling occur behind the angle of the lower jaw, hot linseed-meal poultices should be applied, and all abscesses should be opened as soon as their presence is recognised, even though fluctuation may only be obscurely perceptible. When the inflammation extends to the brain and its membranes, the application of leeches and ice-cold applications to the head, and the administration of active purgatives, are indispensably requisite, to prevent, if possible, exudation into the cranial cavity. If we succeed in subduing the inflammation whilst paralysis of the facial muscles still remains, we must rub in iodine or tartar emetic ointment over the stylo-mastoid foramen, which are very serviceable in promoting absorption of the exudation in the Fallopian canal and effecting a cure of the paralysis.

Nervous Hardness of Hearing and Deafness.

The expressions "nervous hardness of hearing" and "nervous deafness," used as names for diseases, when regarded from a scientific point of view, immediately produce mistrust. They do not, as in the case of the names of the previously considered affections of the ear, furnish any indication of the nature or seat of the disease, but merely describe a

symptom, and a symptom, too, which possesses no diagnostic value, since it is common to all diseases of the ear excepting those which are limited to the auricle.

The term "nervous" is an expression utterly devoid of meaning ; it merely indicates the presumptive cause of the functional disorder to be some lesion of the auditory nerve, but does not even hint at the nature of the lesion. This is strikingly apparent when we examine accounts of dissection of the auditory nerves, and of the organic changes in their immediate vicinity in cases of this disease. Thus it is stated "that the labyrinth is filled up with otoconia ; that there are accumulations of pigment and dark spots, as of extravasated blood ; congestion of the vestibule, yellow discoloration of the osseous substance, slight redness of the periosteum, unusual secretion of the perilymph, unusual depositiou of crystals, and sometimes the appearance of a chalky fluid. As regards the auditory nerves, they may be inflamed, softened, indurated, atrophied, or hypertrophied ; or they may be compressed by the growth of tumours near their central extremities ; crystals of carbonate of lime may be found in the perilymph, and peculiar talc-like particles in the ampullæ ; and lastly, there may be a great deficiency in the number of the fibres of origin of the auditory nerve from the fourth ventricle." Toynbee, whose authority in these matters is prized so highly by Erhard, found in the dissection of fifty-four ears (Nos. 74—793 ; of which Nos. 74—722, and 755—770 must be excluded, because they do not refer to the inner ear, but to the tympanic cavity and the membrane of the fenestra rotunda), atrophy of the auditory nerves (thirteen times, but only in persons who were from sixty to ninety years of age), imperfect structure, and various diseases of both the osseous and membranous semicircular canals, black pigment deposited in the cochlea, constriction of the scala vestibuli of the cochlea, and abnormal quantity of otoconia ; in one instance there was blood in the vestibule, and in another blood in the cochlea ; whilst in a third there were dark flecks on the lamina spiralis in both ears of the same individual, who had fallen on his head some years previously, and had subsequently suffered from deafness.

Now, although it may be very difficult and perhaps even impossible to demonstrate exactly in what manner many of these post-mortem appearances have led to the production of the hardness of hearing and deafness, we must admit, as a general principle, that the healthy performance of its function by the auditory nerve must always be

connected with, and dependent upon its healthy structure. Unfortunately, however, the practitioner gains but little by this ; because no one has ever yet made an attempt to diagnose any of the various organic changes in the labyrinth just enumerated, or to bring them into genetical relation with the functional disturbances. We may remark, in addition, that oftentimes no information can be obtained even from a post-mortem examination in regard to the deafness which has been present during life ; so that in fact the nature and extent of the organic lesions, as they cannot be determined, so they may be wholly disregarded in the treatment. When, therefore, it is considered how few and meagre are the results of dissection, we cannot but think it in the highest degree rash and presumptuous to unite in one category a large number of diseased conditions which have been found in the labyrinth as causes "of nervous hardness of hearing and deafness ;" and as in the case of "chronic inflammation of the tunica nervosa," not only to describe the affection as "very frequent" but actually to subdivide it, as Erhard has done, into "a subacute form (*hyperæmia rheumatica and catarrhalis*) and a chronic form," and this, without any other means for its diagnosis than "the characteristic and persistent rushing sound, unaccompanied by pain," and the "pathognomonic symptoms that the secretion of cerumen is never normal, and that there is diminution of the power of conduction of sound through the bones of the head" (respecting which we shall speak more in detail hereafter). If we add to these the so-called "reflex deafness, hysterical, plethoric, and anaemic deafness, and lastly, the "peculiar paralysis of the auditory nerve," or "dynamic deafness," it will readily be understood how urgently more exact means of diagnosis are required for these imaginary diseases.

It is, moreover, self-evident that we can never correctly apply to any case the term "nervous hardness of hearing and deafness," unless there is a complete absence of all disease of the external and middle ear ; because we have seen that the various organic changes which take place in these parts, are themselves constantly associated with deafness, which is often very complete. But the science of acoustics furnishes us with no means of determining whether the functional disturbance is altogether, or only partially due to such morbid condition. Lastly, the objective mode of investigation, by sight, touch, and hearing on the part of the surgeon, cannot be applied to the diseases of the labyrinth, however practicable it may be for the affections of the middle and external ear ; yet the importance

of such a mode of inquiry for the diagnosis of "nervous hardness of hearing and deafness" is generally admitted, though very imperfectly carried out. If we are desirous of forming a diagnosis of some disease of the external ear, it is only requisite to examine it with a speculum and the direct rays of the sun. For the examination of the middle ear, on the other hand, many aurists, with Toynbee and Erhard, still believe that the experiment of Valsalva is sufficient, although the success of the experiment is actually dependent upon the patient himself; and in the most favorable cases, whilst the duration of the effect is extremely brief, the only information obtained is that the tube is not altogether occluded; no knowledge whatever being gained upon the important circumstance of the presence or absence of free or interstitial exudation in the middle ear. All deductions, therefore, respecting the nature of the diseases of the middle ear, resting on the "experiment of Valsalva," which is supposed to furnish negative evidence for the diagnosis of "nervous hardness of hearing," rest on very uncertain and, in fact, erroneous data. Those who have participated with me in these views, have endeavoured to obtain exact information of the conditions of the middle ear by catheterism and the pressure of air; but hitherto comparatively little success has attended their efforts, because they have only employed a catheter of medium size (about that of No. 3; see above, p. 26), from which positive information could only be obtained in respect to free, and the more severe grades of interstitial exudation. Thus it happened that the middle ear, examined by this imperfect means of observation, was supposed to be very frequently wholly free from organic disease; and in such instances, comprehending nearly 50 per cent. of all aural diseases, the deduction was consequently drawn that the real disease which was present was nervous hardness of hearing and deafness. The error of this deduction could only be recognised, and an accurate knowledge of the more delicate alterations in nutrition and secretion, with the consecutive changes in the size of the middle ear, could only be obtained, by the employment of catheters varying in calibre (p. 26) of the diagnostic tube, and of catgut bougies (p. 32). By this physical method of diagnosis we have ascertained that the number of those deaf persons whose external and middle ear are free from organic changes, and whom, on this account, we are justified in considering the subjects of disease of the internal ear, is reduced to a minimum (4 in 1000, see tabular view, p. 17). But whether this

disease affects the centric or peripheric extremity of the auditory nerve can only be ascertained by a careful inquiry into the presence or absence of cerebral symptoms, of which we shall speak hereafter.

To this objective, and therefore certain mode of diagnosis (even if it be also negative) of "Nervous hardness of hearing and deafness," Erhard and Bonnafont have preferred a subjective, functional, very uncertain, and still only negative diagnosis. According to Erhard, "the most general physiological and pathological symptom of all (?) nervous deafness is diminished conduction of sound through the bones of the head so that an ordinary watch cannot be heard at all, and a timepiece only seldom, and then very imperfectly." Here, then, the determination of the presence of very serious disease of the ear is made to rest altogether upon the observation of the patient himself, delusive as this frequently is, and upon his power of hearing certain movements of a watch? The unlikelihood of having a clock at hand in many cases, and the uncertainty in others as to whether it is really only "very imperfectly heard," is still further increased by the statement that "the conducting power of bones of the head for sound is diminished by age, and also to a remarkable extent by great thickness of the diploë and of the integuments of the head," and "that only those are nervously deaf in whom this conducting power of the cranial bones fails, and who do not exceed forty years of age;" and lastly, "that those only amongst younger persons can be considered nervously deaf who are unable to hear a watch through the bones of the head." What age then must those "younger persons" be when the fortieth year has been declared the limit of the occurrence of nervous deafness? and how shall the nature of the hardness of hearing be determined in persons over forty years of age? How are we to ascertain that the diploë and the investing soft parts are too thick, or that in such cases the inability to hear "a watch or a clock through the bones of the head" is indeed no proof of nervous hardness of hearing. What conclusion can we draw in respect to this "functional diagnosis" if "patients who present well-marked (?) symptoms of nervous deafness can also be at the same time acoustically deaf." These questions Erhard will find it difficult to answer satisfactorily; but in the mean time they furnish a proof, that we must be very much prejudiced, if, in opposition to the comments now made, and to the limitations in their value which even Erhard himself acknowledges to exist, we still consider that

the diminished conduction through the bones of the head is "the most general physiological and pathological symptom of all nervous deafness." Bonnafont makes it a very easy matter; for he asserts with much satisfaction that he has made a new and important diagnostic discovery, "that the sensibility of the auditory nerves must be quite normal"—"si la montre est entendue sur toutes les parties du crane." If the watch be heard only when placed upon the mastoid and zygomatic processes, the hardness of hearing may still be curable. If the watch is inaudible when resting upon any of the cranial bones, whilst a tuning-fork (vibrating "ut" of the third octave) can still be heard at five centimetres distance from the ear, or at least by being applied to any part of the cranial bones, the curability of the deafness is at best but doubtful, whilst, lastly, if the tuning-fork can only be heard at a very short distance, or when directly applied to the cranial vault, the incurability of the disease is indubitable. But here, again, the difficulty occurs, that it rests with the patient to determine whether he does, or does not hear "the watch or the tuning-fork" when in contact with any particular point of the cranial bones—a matter of fact which cannot be stated with certainty by the uneducated, or the disconcerted, by the very young or old, or by the very nervous patient. It is, indeed, by no means an easy task for a deaf person to decide whether he can really hear the vibrations of the tuning-fork or only feel them through the cranial bones. Lastly, in consequence of the very various strength in the beats of watches, their audibility on being applied to the cranial bones of those who are hard of hearing varies considerably; so that, according to Bonnafont's principle, we can quite at pleasure make cases of nervous deafness either very frequent or very rare, according as we apply to the cranial bones, watches the movements of which are very strong or very weak; for instance, thousands of my patients affected by the most various kinds of deafness, have not been able to hear my feeblest ticking watch, which is normally audible at twenty-one inches, even when it has been actually applied to the cranial bones; all these, therefore, according to Bonnafont, ought to have been considered cases of nervous deafness, but, on the other hand, they could distinctly hear my strongest-beating watch, which is normally audible at forty feet, when applied to any part of the skull; and should, therefore, not be described, according to Bonnafont, as cases of nervous deafness. It will, therefore, we think, be admitted that—1. The organic changes observed upon

dissection of the auditory nerves and the surrounding solid and fluid parts, are still utterly unknown so far as regards their power of causing the destruction of the function of the auditory nerves and of producing nervous hardness of hearing. 2. That we have no certain means of diagnosing during life any one of the known organic changes of the auditory nerves, or of the fluid and solid parts in their vicinity (in those cases at least in which the temporal bone is not carious), whilst we must also acknowledge that the objective investigation of the external and middle ear can alone determine the presence or absence of organic changes in these several parts, and can thus only render possible (*i. e.*, in the cases of absence of organic change) the recognition of a nervous hardness of hearing and deafness. 3. That it is quite impossible, where there are organic changes present in the external and middle ear, to diagnose with any approximation even to correctness the diseased condition which may exist in the internal ear. 4. And that it is only in complete deafness that we can, without investigation of the diseased ear, assure ourselves of its being purely nervous, because there is no kind of abnormal change in the organization or of the atomic constitution of the parts in the ear which can take away from them the power of conducting sound to the auditory nerve.

But when complete loss of hearing is present, the auditory nerve must have lost its sensibility for sound, let the organic condition of the ear be what it may ; and notwithstanding the innumerable grades of diminished functional activity of the auditory nerve (nervous hardness of hearing) which may be present, still they do not exist, so far as the diagnosis is concerned, which only recognises one single form of disease of the internal ear, namely, nervous deafness, or in other words, annihilation of the functions of the auditory nerve, without regard to the anatomical and pathological conditions that may have produced it. Moreover, if we are not desirous of losing ourselves in unsupported hypotheses, we cannot at present touch upon the origin, symptoms, progress, prognosis, and treatment of nervous hardness of hearing, since the mode of transition to that form of deafness is entirely unknown, and perfectly inaccessible to any of our means of diagnosis.

Nervous deafness occasionally, though rarely, originates in a gradually increasing hardness of hearing, but far more frequently it comes on quite suddenly, after some violent shock to the whole

body, or the head alone; such as a fall from a considerable height on the feet, buttocks, back, chin, or upon the head; from blows on the head or ears, from violent explosions of artillery in the immediate neighbourhood; from apoplexies; or it may supervene in the course of severe and dangerous febrile diseases; or lastly, after exposure to long-continued and very cold draughts of air applied directly to the ears. Whether it be possible for one ear alone to be completely destitute of hearing, that is, nervously deaf, or not, without carious destruction of the petrous portion of the temporal bone, must remain undecided, because loud sounds, used as tests, afford no means of positively determining the healthy from the unhealthy ear, whilst weak sounds also give no satisfactory means of forming a decisive judgment as to whether one or both ears have lost the faculty of hearing.

The symptomatology of nervous deafness is not so simple. The patient is indeed incapable of hearing anything; but he can readily feel strong vibrations in the air and on the ground upon which he stands, walks, lies, or sits. Nearly all suffer from persistent, variously modulated noises in their ears, and therefore furnish a striking proof that this symptom does not proceed from any morbid condition of the auditory nerve, the functions of which are in these cases so completely abolished.

Nervous deafness, commencing at the periphery, is quite free from cerebral symptoms (with the exception of frequent fainting fits), but these on the other hand are very characteristic of gradually increasing deafness, commencing at the nervous centres, and produced by various kinds of pressure or irritation on the auditory nerves in their course through the cranial cavity. Amongst such cerebral symptoms may be enumerated, continuous fixed pain in the head, loss of memory, paralysis of the optic nerves, or of the motor nerves of the eye, or of the same side of the face, and lastly, fainting.

The prognosis for both forms of nervous hardness of hearing is in the last degree unfavorable, providing we do not confound great hardness of hearing with absolute deafness, a mistake that is by no means uncommon. I have at least never met with a case which has been cured, or even materially improved by treatment. Centric deafness, occasioned by blood or serum being poured out at the base of the brain, might, if it were recognised, afford some prospect of relief, or cure, since the absorption of these fluids is not absolutely impossible.

The treatment of nervous deafness, however hopeless, can

only be based, in the absence of any special indications, on general principles. Where the deafness results from the above-mentioned violent mechanical causes, serious febrile conditions, &c., we presume that there is local congestion or some other organic change, either in the auditory nerves themselves or in their immediate vicinity ; so that we are quite justified in using those general and local derivative means which are calculated to promote absorption. Upon the details of these I need not here dilate, as I have already stated, that not one single case has occurred in my practice in which any benefit has been experienced from the use of these remedies. The prospect of success, therefore, being so slight, it is surely judicious to avoid tormenting the patient by the application of painful or debilitating counter-irritants, such as setons, moxas, large issues, violent purgatives, &c.

On the other hand, it is quite unjustifiable to attribute nervous deafness to nervous debility, and, proceeding on this supposition, to employ the so-called excitants, amongst which electricity in its various forms, applied as a constant or induced current, plays the most important part ; for this method of treatment, like the former, is unable to adduce a single well-established cure ; it only offers a wide and profitable field for greed and charlatanry.

Deaf-mutism.

Deaf-mutism depends upon congenital or acquired extreme hardness of hearing, or complete deafness. The deafness, however, must have been present before the first six or eight years of life, that is to say before the acquisition of written language, and before vocal sounds have been learnt by intercourse with others. When the deafness has been complete at birth, articulate sounds are never learnt, but when the deafness is acquired at an early period, they may indeed be learnt, but are soon again forgotten. In the former case the little patients remain, in the latter they become dumb. Congenital deaf-mutism is probably far more frequent than acquired ; certainly more frequent than appears from the statistics hitherto given, since the parents of deaf-mutes, readily delude themselves as to the power of their children to hear during the first and second years of life.

The deafness of the deaf and dumb is not always complete. In 45 cases of deaf-mutism there were found 27 cases of congenital deaf-mutism, and 18 cases of acquired deaf-mutism.

	Congenital.	Acquired.	Total.
With complete deafness	10	13	23
With some perception of sound	5	3	8
With uncertain perception of vocal sounds	7	1	8
With distinct perception of vocal sounds	2	0	2
With hearing for all words of which they had acquired a knowledge by education	2	1	3
With hearing for all words, whether they had been taught them or not	1	0	1
	—	—	—
	27	18	45

In the last two cases the words, which were always unconnected, were spoken to the deaf-mutes with the mouth so close to their ears, that it was impossible they could see the movements of the lips. The deaf-mutes belonging to the last two or three categories are called partial deaf-mutes, though their social position in no respect differs from their unfortunate companions. The slight power which they possess of hearing, no doubt, facilitates their acquirement of speech, and makes the tones of their voice less rough ; but they are never in a position to attend schools with other children who are in the full possession of their senses with advantage, to learn articulate sounds like them, or, like them, to choose and follow any of the ordinary avocations of life. This must be borne in mind, in order that we may determine whether any of the pretended cures of these unfortunate children, have really attained their object, for it is not enough that they should be able to perceive and repeat a few letters, syllables, words, or short sentences, to permit us to acknowledge that a cure has been effected ; for even when they have accomplished this, they are still unable to be separated from the ranks of the deaf-mutes, and no real cure has been wrought.

At the commencement of the second year of life, or occasionally a year or two later, children in the full possession of their senses begin to acquire articulate sounds, from their intercourse with those who speak ; if, therefore, at this period, there be a total absence of the usual early attempts to speak, the suspicion of present deafness arises, which acquires strength with the lapse of each month, until at the close of the second or third year of life, without the acquisition of any articulate sounds, no further delusion can exist upon the subject, however the relatives of the patient may adduce imaginary proofs of the child's capacity to hear.

As regards the seat of the deafness in deaf-mutism, after the full

explanations into which we entered when describing nervous hardness of hearing and deafness, we must attribute it to lesion of the peripheric or of the centric, or even of both extremities of the auditory nerves. It is obvious that in all cases there must be complete inability to conduct sound in both nerves. In congenital deaf mutes, the following morbid conditions have been particularly remarked on dissection :—Defective development of the semicircular canals and of the cochlea, atrophy of the auditory nerves, and deficiency of the striæ auditoriæ on the floor of the fourth ventricle : but in many, perhaps even in the majority of cases, no structural changes are discoverable either in the labyrinth or in the centric extremity of the auditory nerve.

In acquired deaf-mutism, similar organic lesions have been found to those which are present in nervous deafness—lesions, which are as completely hidden from physical inquiry and diagnosis during life as are those which accompany congenital deaf-mutism. I have myself examined a considerable number of deaf mutes with the aural speculum, aural catheter, diagnostic tube, and catgut bougies, but, with the exception of the above-mentioned inflammation and perforation of the membrana tympani, ulcerated ossicula, and inflammation of the membrane lining the tympanum, &c., I have always found the external and middle ear quite normal, and apparently not in any way instrumental in causing the deafness. At all events, I am convinced that collections of cerumen in the meatus, or of free exudation in the middle ear, are insufficient to produce complete deafness or even such a degree of hardness of hearing as must necessarily be present in any case of deaf-mutism, either congenital or acquired.

Deaf-mutism, that is to say, deafness producing dumbness, is not an hereditary disease. Amongst the parents of forty-five deaf-mutes above-mentioned, only three suffered from hardness of hearing ; the remainder were in full possession of their hearing. In the year 1855 I found in Berlin, amongst 198 deaf mutes, eighteen men, six of whom had married women who were deaf mutes, and twelve, women who heard perfectly. Of the six former couples five had families, and of the twelve latter, eleven had children, all of whom could both hear and speak well. In the Hertford Asylum for the deaf and dumb at Boston, in North America, there were in 1851, 200 deaf mutes, of whom 103 were married. Thirty-one of these couples were childless, the remaining seventy-two had 102 children, of whom ninety-eight were in full possession of voice and hearing, whilst the remaining four were deaf mutes. One

of them was the child of parents who were both congenital deaf mutes ; the others were the offspring of a mother who was a congenital deaf mute, and of a father who acquired his deaf-mutism in his second year. In 1851 there were in Ireland 427 deaf mutes in 329 families ; amongst these the father had been a deaf mute only twice ; the mother four times, the grandfather five times, and the grandmother three times. But it is a noteworthy circumstance that the deaf and dumb children in 217 families had, more or less, numerous deaf mutes amongst their male or female cousins.

Consequently, nothing can be urged against the marriage of deaf-mutes with healthy people in the full possession of speech and hearing, on the ground of the defect being likely to be propagated to their issue. Acquired deaf-mutism occurs most frequently within the first six or eight years of life after severe fevers, whether cerebral excitement, convulsions, and loss of consciousness have been present or not ; after convulsions with loss of consciousness, but without fever ; after scarlet fever, measles, smallpox, severe chills, violent concussion of the head from falls, blows, &c. It often appears quite suddenly, but the deafness is always fully established in a few weeks. It then continues quite unchanged, even if the patient, whose constitution has been severely shaken by the original and often very dangerous febrile disease, be completely restored to health. Children, in particular, who have been thus affected, are often left in so debilitated a state that months often elapse before they are again able to stand and walk.

Of the eighteen cases above adduced of acquired deaf-mutism, seven resulted from severe nervous fevers, four from convulsions with loss of consciousness, three from scarlet fever, three from inflammation of the brain, and one from exposure to severe cold. Only in one of these cases did the power of hearing return during convalescence to a sufficient extent to enable the child to understand vocal sounds and words, of which he had already acquired a knowledge by education, when the mouth of the speaker was placed close to his ear. Amongst congenital deaf mutes three out of twenty-seven possessed this degree of the faculty of hearing.

Simulated deaf mutes betray themselves usually by shaking the head and pointing the finger to the tongue and ears, whilst real deaf mutes are not aware that the ears are subservient to hearing or the tongue to speech. If these deceivers appeal to the fact of their having received a pretended methodical education, we must

have recourse to the advice of a deaf-mute teacher in order to unmask them ; but, should even this fail, we must admit them into the hospital and administer chloroform, under the influence of which the tongue of the most crafty dissembler becomes loosened.

The prognosis of deaf-mutism is very unfavorable, and I have no hesitation in calling it an incurable disease ; because, on the one hand, the morbid conditions of the auditory nerve producing the deafness are as completely unknown as are the curative means that might prove serviceable, and, on the other hand, a great variety of remedies have been employed, but hitherto without any good results. This statement requires that the indications for the treatment of this disease should be considered somewhat in detail. As we have already said, deaf-mutism results from the circumstance that, owing either to acquired or congenital deafness, the power of speech is either never acquired or is lost at an early period ; the cure of the deafness, therefore, must reproduce this process of development, *i. e.*, a case of cured deaf-mutism ought to learn, in the course of a couple of years, a period sufficient for the youngest child, without any methodical education, but merely from intercourse with those who speak, the tones of the voice, as they are wont to be learnt and spoken by children of three years of age in full possession of their senses. Deaf mutes, therefore, who have been really cured ought to be in the same position as children who are perfectly organized, even amongst the poorer classes of society ; ought to be able to converse orally upon the occurrences of everyday life, not only with their teachers, but with every person they may meet, and ought, therefore, to be able to attend, with advantage to themselves, an ordinary day-school for healthy children, and, like them, to be able to select some occupation by which they may gain their livelihood.

When this, however, does not come to pass in cases where it is pretended that the deaf-mutism has been cured, no real cure of the deafness, nor even any noteworthy improvement of it, has been effected, since mutism is only produced by complete, and never by partial deafness, unless indeed it be of the very highest grade. Measured by this—the only valid means for forming an estimate, deaf-mutism has never yet been cured. No deaf-mute has ever yet acquired the power of speech by simple intercourse with those who speak, nor attended with advantage a school for children who had the perfect use of their ears and tongue, nor could select and fulfil the duties of a calling in life, unless he have had the advantage of

a properly directed and methodical education. If this cannot be denied or contested, the so-called cures of deaf mutes should no longer be published, since they only indicate charlatanism or an unpardonable ignorance of the essential conditions of deaf-mutism. The most recent statements of this kind have proceeded from MM. Bamberger, Duchenne, and Blanchet. Bamberger has electrified his patients for months at a time for two years consecutively. Duchenne has "Faradized" a deaf-mute boy months together for three years. Blanchet treated several classes of deaf mutes for years with "vocal and auditory gymnastics," and with private instruction, and yet the children improved no further than that they were able to say after him, "letters, syllables, and a few words or short sentences, such as 'bon-jour, Monsieur Duchenne,'" &c.—an improvement in the comprehension of the speaker which we are by no means certain did not result rather from the eye than the ear. But even granting the latter, the feat is only what many deaf and dumb children can accomplish (as I have elsewhere stated), without their ceasing to be considered deaf mutes, and to require a proper methodical education, through the sense of sight, &c. After such performances in hearing and speaking, Bamberger, Duchenne, and Blanchet consider their pupils cured, and as requiring only careful and continued instruction, conveyed through the hearing, to enable them to acquire speech; without regard to the circumstance that they would have done better to have attended to this—"acquisition of speech" before publishing the cases as cures of deaf-mutism. This, however, could never have been accomplished, since these very cases have never yet learnt to speak, and they err greatly in thinking that the teachers were ever able to convey information to the patients by shouting loudly into their ears. Moreover, those who are hard of hearing cannot endure the effort of listening required to comprehend the loud shouting of another person into their ears, independently of the fact that deaf mutes whose deafness has been cured ought to acquire the power of speech with the same facility, by simple intercourse with those who speak, as is the case with young children who are in the full possession of their senses.

The treatment, therefore, has nothing to do with "conversational exercises" on the part of the patients, but consists simply in the removal of the causes of their deafness. It is highly unphilosophical to think, as Erhard does, that "every case of deaf-mutism is acquired, and is caused by some centric lesion," and that "numerous observa-

tions show that only some centric nervous process is at the bottom of acquired deaf-mutism ;" for these "observations" can only consist in accounts of dissection in cases of deaf-mutism ; and it would have been well had he thought fit to publish them, since such examinations have only been made in very small numbers in other quarters. As long as Erhard does not do this, we may look upon his "numerous observations" as only another instance of the rash and unfounded statements of this author, and altogether discard them. We might, perhaps, feel tempted, as an experiment, to try his proposed means "of causing the absorption of the peccant material from the fourth ventricle by the application of a cold-water douche of the size of the thumb upon the back of the head, whilst the patient is in a warm bath," if this had hitherto furnished any other than "apparent success."

Toynbee requires in the treatment of deaf-mutes, but only in cases of acquired deaf-mutism, a certain degree of the faculty of hearing. "The nervous system of the ears must then be excited to natural action by the persevering use of the long elastic tube, and where either the membrana tympani or the mucous membrane lining the tympanum has been thickened, counter-irritation over the mastoid process will aid the use of trumpets." Toynbee only adduces three cases where, by the use of these remedies, he was convinced that the hearing was decidedly improved. In the first case counter-irritation and the use of the long elastic tube were recommended, but he does not state whether both were applied. The improvement experienced in the hearing was of no account. In the second case the same treatment was applied for four months. After that time Toynbee received a letter from the patient's sister—not having examined her himself—saying that "they do think she is improving," a statement which, in a matter of such extreme scientific interest, is perfectly valueless as to the beneficial effects of a particular line of treatment. In the third case Toynbee determined to try a plan of treatment having for its object the excitement of the nervous apparatus of the ear ; but here also he leaves us in doubt as to whether it was applied, and had produced the supposed "improvement" of the hearing, or not. We shall not, therefore, be much in error if we attribute but little scientific value to either the indications for treatment, remedial measures, or success in the treatment of this particular disease by this author.

In those cases of deaf-mutism which have occurred after violent

concussion of the head, or after convulsions, febrile attacks, or inflammation of the brain, or, lastly, after the exanthemata, with destruction of the membrana tympani, and swelling and suppuration in the tympanic cavity, strong counter-irritants (setons, counter-irritation to the shorn scalp, behind the ears, or on the neck, issues in the arm) have been continuously and energetically applied, and the body has been lowered by spare diet and active purges, for the purpose of removing imaginary discharges of serous or bloody fluid in the neighbourhood of the auditory nerve; and all without arriving at any other result than an extraordinary diminution in the general strength of the patient. Passing to another extreme, electricity has been employed, in order to remove the supposed, and certainly very obvious inactivity, of the auditory nerve, but without the smallest success either with the induced or continuous current.

Since nothing positive can be predicted in regard to the cause of deaf-mutism, the deafness can only be referred to some one of the already described aural diseases; and any measures undertaken for the treatment of deaf-mutism must be founded on careful physical examination of the external and middle ear, the internal ear, which is here so important, being unfortunately inaccessible. Should any morbid conditions of the external and middle ear be present, these of course must be treated and removed, according to the rules which we have laid down in the sections appropriated to their consideration. But in the mean time, we may perhaps perceive that the extraordinary difficulties which beset the treatment of deaf-mutism are partly caused by the frequent concurrence of chronic inflammation of the perforated membrana tympani, and of the exposed, much swollen, and spongy membrane of the tympanic cavity. How far, and in what manner, this chronic inflammation affects the internal ear, and produces changes in its organization, has unfortunately not yet been shown by dissection.

Amongst the diseases of the middle ear, when the membrana tympani has been whole, I have found "exclusively interstitial exudation" a frequent concomitant, the removal of which, in a completely (acquired) deaf mute produced such recovery of the hearing power in the right ear, that the little patient heard and repeated all letters, syllables, words, and short sentences which were spoken with the mouth closely applied to his ear; but he was not on that account fitted to receive education with children in the perfect possession of their senses, nor to be removed from the category of deaf mutes.

When no apparent morbid changes are present in the external or

middle ear, we must suppose that the seat of the deafness is either in the peripheric or centric, or even in both extremities of the auditory nerve; but as the nature of the affection (whether it be due to non-development, or some disease subsequent to birth), is wholly unknown, no diagnosis can be made, and it would be very foolish to undertake the treatment; we must therefore consider such deaf mutes incurable, and it only remains for us to see that they are subjected to a well-directed, methodical education, founded upon the sense of sight.

Tabular Arrangement of the Diagnosis, Prognosis, and Treatment of the Diseases of the Ear.

Name of the disease.	Diagnosis.	Prognosis.	Treatment.
Inflammation of the dermis of the cartilage of the ear	A hot, dark red, very tense, shining, painful swelling develops itself with acute febrile symptoms on the cartilage of the ear, which extends over the face and the scalp as far even as the opposite ear. It terminates within nine days by desquamation of the affected parts. Moderate swelling shows itself in one or both ears, with redness, and formation of vesicles with serous or purulent contents, sesses of age of the patient and the duration of the affection. Dyeserasia is Fowler's solution of arsenic.	Favorable except so far as regards its tendency to implicate the membranes of the brain	Treatment of the fever. General constitutional measures especially directed against the dyscrasia. The most effectual locally, only cleanliness is required.
Inflammation of the connective tissue of the cartilage of the ear	Acute form. Chronic form.	Extremely unfavorable, and varies easily bleeding cracks and chaps occur, or a cachetic state of the constitution terminating in thickening concomitant with considerable irritation, terminating in unhealthy, acrid suppuration, with thickening concomitant and degeneration of the auricular cartilage, &c.	Hot bread poultices to the swelling.
Inflammation of the peri-chondrium of the ear		Very favorable	Very rarely general antiphlogistic treatment is required. The patient's general health must be supported, especially in those who are debilitated, melancholic, and imbecile.

Inflammation of the cuticle of the meatus and of the myral speculum, with clear illumination which it filled with ceruminous matter	On investigation of the meatus by means of a caoutchouc syringe and ink-warm water.	Very favorable	Injection of the ear by means of a caoutchouc syringe and ink-warm water.
Inflammation of the corium of the meatus	Favorable when the disease is in the whole course of the meatus, with remarkable good; otherwise very unfavorable. In caries of the meatus or of the tympanic cavity the swelling is constantly smooth, very hard, and limited to the posterior third of the meatus	Very favorable	Constitutional remedies directed to any constitutional affection that may be present. If there be none, only local injections of warm solutions of sulphate of zinc.
Inflammation of the connective tissue of the meatus	Violent stabbing, tearing pains, and beating in the ears. At the entrance of the meatus one or two extremely sensitive, and usually colorless tumours, about the size of a pea, and elastic, closing up the meatus without secretion, readily opening spontaneously, and discharging blood and pus; quickly healing	Very favorable	Hot bread poultices day and night until the tumour bursts, when the pain completely disappears.
Inflammation of the periosteum of the meatus	Thin, dark coloured, suppuration in the meatus, at the bottom of which the blunt probe, to hypertrophy of the corium passing through a fistulous opening, strikes with exfoliation of carious bone against the carious, bony meatus	Very unfavorable, leads easily to perforations of the corium, and with exfoliation of carious bone	Internally anti-scorfulous remedies; locally, only daily injection with warm water.
Acute inflammation of the membrana tympani	Violent pain in the ears occurring suddenly, occasionally accompanied by febrile symptoms, heal easily, and without any scar and moderated by the early suppuration. Meatus healthy, but without cerumen. Membrana tympani much reddened, extremely sensitive, opaque, dull, flat, and thickened	Very unfavorable. Perforations of the corium, heal easily, and without any scar	To keep in the house, with perfect rest and proper diet. Locally, mild injections, application of numerous leeches around the ear, and instillation of warm oil.

Name of the disease.	Diagnosis.	Prognosis.	Treatment.
Chronic inflammation of the membrana tympani	No fever, no pain; yellowish-green, dark coloured, fetid, irritating, and frequently sanguinolent discharge. Meatus healthy, without or cerumen. Membrana tympani degenerated, shining, transparent cicatrices. more or less red and spotted in appearance. Poypi may be safely removed sometimes partially, at others completely, destroyed, with either long or short-stalked polypi attached to it	Most unfavorable. Perforations heal with great difficulty, injections, instillation of solutions of sulphate of zinc, acetate of lead, &c.	Local treatment alone effectual; injections, instillation of solutions of sulphate of zinc, acetate of lead, &c.
Catarrhal inflammation of the middle ear, with suppressed exudation	Meatus and membrana tympani healthy. Air blown into the tube through catheter No. 1 passes in easily, fully, continuously with dry sound, and with increase of the fullness and hardness of hearing into the tympanic cavity	Favorable in recent cases	Only local: blowing into the tympanic cavity a few drops of a warm diluted solution of Liq. potassæ.
Catarrhal inflammation of the middle ear, with free exudation	Meatus and membrana tympani healthy. Air blown into the tube through catheter No. 1 or 2 does not pass, but through catheter No. 3 or 4 passes easily and continuously, with moist sound, and with great improvement in the comprehension of speech and in the noise in the ears	Very favorable	Strong propulsion of air through catheters Nos. 3 and 4, after which a few drops of solution of sulphate of zinc into the tympanic cavity.
Catarrhal inflammation of the middle ear, with free opaque exudation	Meatus often dry. Membrana tympani often opaque. Air will not pass through catheters much as whilst the free exudation constitutional disorder, air should Nos. 1 and 2; through 3 and 4 only with effort and slightly moist sound, with a littlest exudation can with certainty, the instersti. be blown through catheters Nos. 3 improvement of the hardness of hearing and of taintly he removed noise in the ears, which soon ceases. Bongies introduced into the tube remove contractions	Only in part favorable, inas.	After paying attention to any

Catarrhal inflammation of the middle ear, with exclusively interstitial exudation	Meatus dry. Membrana tympani very often opaque, white. Air blown into the tube even through catheters Nos. 3 and 4, passes with difficulty, often only by fits and starts, in a very thin, constantly dull, and dry stream, and with increase in the severity of all the symptoms, especially if the operation of blowing in air be frequently undertaken, and if much force be used	Very unfavorable	Locally, no blowing in of air. But bougies or catgut are to be introduced into the tube, and a few drops of solution of nitrate of silver should be propelled into the tube and into the tympanic cavity
Noise in the ears without hardness of hearing	Loud, continuous noise in both ears, with normal power of hearing and normal condition of the external and middle ear	Apparently favorable	Blowing in of a solution of nitrate of strichnine through catheter No. 1 into the tympanic cavity
Nervous otalgia	Violent and deep-seated pain in one ear in connection with present or previously occurring toothache on the same side, with normal power of hearing, and with normal condition of the meatus, membrana tympani, and middle ear	Very favorable	Removal of the carious molars which cause the pain in the ears removes the disease.
Acute inflammation of the labyrinth	Fever, sudden supervention of deep-seated pain in the ear, with cerebral symptoms. Meatus healthy. Membrana tympani torn by external violence. Tympanic cavity full of blood, bloody serum or thin pus	Very unfavorable	Thoroughly antiphlogistic.
Chronic inflammation of the labyrinth	After protracted inflammation of the membrana tympani, with discharge from the ear, not typical rigors indicate especially danger to life	Very unfavorable. Typical or dull pain is felt in the ear, the temporal bone,枕骨, and occiput, which is increased by all shocks, blows, &c. The membrana tympani is perforated. The spongy, swollen, and partially destroyed membrane of the tympanic cavity is painfully sensitive.	Antiphlogistic. Leeches to the ears, application of ice to the occiput, counter-irritant ointments, strong purgatives.
			Caries in the tympanic cavity, severe cerebral symptoms, suppuration, fever, paralysis of the face, &c.

Name of the disease.	Diagnosis.	Prognosis.	Treatment.
Acute inflammation of the facial bone	Violent tearing pain in the face, and in the ear of the same side; paralysis of the facial muscles; acute fever. A few days later noise in the ears, and hardness of hearing; deafness; brain symptoms; meatus and membrana tympani healthy. Abscess in the foramen stylo-mastoideum	Dangerous, but not incurable	Active antiphlogistic measures: maturation and opening of the abscess.
Nervous deafness	Complete loss of hearing, with extremely variable organic conditions of the external and middle ear	Highly unfavorable	Only very empirical local stimulating means recommended.
Congenital and acquired deaf-mutism	Inability to acquire speech by intercourse with speaking men, on account of total or partial deficiency of the power of hearing; or inability to keep up the already acquired vocal sounds, on account of ignorance of the written language	Quite hopeless	Without any reasonable indication of cure.

A P P E N D I X.

ON MECHANICAL APPARATUS FOR THE IMPROVEMENT OF HEARING.

As soon as the power of hearing in both ears is so much impaired as to render ordinary colloquial intercourse difficult or altogether impossible—a condition which may terminate in the members of the patients' own family finding it difficult to communicate with him, even when in close proximity—and when no relief can be obtained from the resources of medicine, acoustic apparatus must be employed. These vary as much in shape as in the material of which they are constructed, and are yet of but little service to the patient, which need not surprise us, when we reflect upon the extremely imperfect knowledge we possess of the laws of acoustics and of the physiological importance of the several parts of the organ of hearing.

For those who are hard of hearing, the simplest mode of relief is to direct the auricle forwards, either with the whole hand, which increases the surface for the reflection of sound, or with the finger only. The more the auricle is directed forwards and stretched, the sharper will be the resonance, and the more distinct the reverberation of sound, as may be clearly perceived with the healthy ear. Thus by placing the hand behind the ear, we have a readily applied and efficient means of relief for hardness of hearing.

The ordinary apparatus for the improvement of the hearing presents two principal forms ; the first only collects and concentrates the passing waves of sound, without in any way affecting their character, except by sharpening them, and remarkably increasing the resonance ; the second affords the means of maintaining conversation with a single individual, or in general society. A point of primary importance in the construction of these instruments is the material of which they

are made, as funnels and tubes of caoutchouc and the elastic tube constructed by Dunker; or, on the other hand, funnels and trumpets of metal, gold, silver, copper, brass, and iron. And another important point is their form, whether they are merely elastic tubes or are fashioned as sound-collectors of various size and whether made of caoutchouc or metal. Usually both points are attended to.

Those who are hard of hearing can generally understand best when they are addressed slowly and with distinct articulation, and with a strong, but not elevated clear voice; sharp screaming voices, on the contrary, do not make themselves readily intelligible to the deaf. We might therefore almost anticipate that metallic ear-trumpets, which render sound more acute without making it clearer, afford as a rule little or no relief, but, by over-exciting the auditory nerve, actually rather deteriorate the power of hearing, exactly in the same manner as too bright a light injuriously excites the optic nerve.

If the patient desire to hold intercourse with persons whose organ of voice is extremely weak, he should employ Dunker's tube, or one composed of vulcanized India rubber, with a short wooden funnel at one extremity, to which the speaker must apply his mouth, and with a thin leathern or India-rubber prolongation at the other end, which can be inserted into the ear of the patient. Such tubes may be of any length; they do not in any way alter the sound of the voice, and are most efficient when spoken into with the usual tone of the voice. When this kind of tube ceases to be of service to the patient, a larger funnel of vulcanized India-rubber may be employed, or the same instrument may be stiffened and varnished. Gutta-percha ear trumpets are still more efficient, but they give a remarkable degree of sharpness to the sounds transmitted through them, which is often injurious. The most common form is a flattened trumpet of sufficient size to cover the ear. Usually two of these trumpets are united by a steel spring passing over the head and conveniently retaining the inner extremities in the ears. With the increase of the size of these variously formed ear-trumpets and especially of the sound-collecting extremity, the strength of the sound transmitted increases, but it must be remembered that their stimulant effect upon the auditory nerves is correspondingly injurious, and therefore they should only be used as seldom, and for as short a time as possible, if we wish to avoid the rapid increase of the hardness of hearing.

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